VARICOSE VEINS

H. O. Mc PHEETERS

VARICOSE VEINS

WITH SPECIAL REFERENCE TO THE INJECTION TREATMENT

BY

H. O. McPHEETERS, M.D., F.A.C.S.

Director of the Varicose Vein and Ulcer Clinic, Minneapolis General Hospital; Attending Physician New Asbury and Fairview Hospitals; Associate Staff of Northwestern Hospital, Minneapolis, Minn.

ILLUSTRATED WITH HALF-TONE AND LINE ENGRAVINGS

PHILADELPHIA

F. A. DAVIS COMPANY, PUBLISHERS

1929

PRINTED IN U. S. A.
PRESS OF
F. A. DAVIS COMPANY
PHILADELPHIA, PA.

INTRODUCTION

The author has often been impressed with the amount of disability that accompanies the extreme and complicated cases of varicose veins and by the fact that such patients may become invalids for life, when under proper care and treatment they might again be made useful members of society. He does not believe that the medical profession as a whole realizes the importance of this condition and how miserable may be the patients so afflicted.

The time honored and accepted excision of the offending vein, in the hope of cure, has been unsuccessful in such a large percentage of cases that we must seek new and more effective methods of treatment.

The author has often seen the varices redevelop and recur even though cared for by the most able surgeons. Long periods of hospitalization were entailed when the wounds became infected and the process of healing left an unsightly scar. Oftentimes the patients continued to suffer with their disability because they could not give the time for the hospitalization demanded by the operative treatment, where they could easily arrange for the office visits when treated by the more modern methods. It was this array of evidence as to the shortcomings of surgery

that caused the author to adopt the injection treatment for varicose veins.

This short compilation is a resumé of a most thorough investigation of the literature throughout the world—wherever this work has been done—combined with the care and treatment of approximately 800 cases actually treated. Most of this practice has been at the Out Patient Department of the Minneapolis General Hospital where the author is in charge of the varicose vein and ulcer work.

The author wishes to give credit to Dr. Lufkin, pathologist of the Minneapolis General Hospital and assistant to the department of pathology of the University of Minnesota, who has contributed the chapter on the Pathology of Varicose Veins and the Pathology Developing Following the Injection Treatment.

The author also wishes to give credit to Dr. Carl O. Rice, for his able assistance in the dispensary work and his many valuable suggestions throughout the preparation of this book.

CONTENTS

PAGE

CHAPTER I.

Anatomy 11

CHAPTER II.

Embryology 18

CHAPTER III.

Etiology 26

CHAPTER IV.

Diagnosis and Differential Diagnosis 39

CHAPTER V.

Direction of Venous Flow in Varicose Veins 43

CHAPTER VI.

The Complications Associated with Varices 53

CHAPTER VII.

Ulcer Cruris 58

CHAPTER VIII.

Treatment in General 66

CHAPTER IX.

The Operative Treatment 71

CHAPTER X.

History of Injection Treatment 82

CHAPTER XI.

PAGE

Solutions Used 87

CHAPTER XII.

Indications for Injection Treatment of Varicose Veins 92

CHAPTER XIII.

Armamentarium 97

CHAPTER XIV.

Technic of the Injection 105

CHAPTER XV.

Post-injection Treatment 117

CHAPTER XVI.

Results of Injection of Varices with Sclerosing Solutions 122

CHAPTER XVII.

Pathology, Gross and Microscopical, Following the Injection Treatment 132

CHAPTER XVIII.

Complications Directly Following the Injection Treatment .. 147

CHAPTER XIX.

Complications Coincident or Associated with the Injection Treatment 154

CHAPTER XX.

The Treatment of Ulcer Cruris 156

CHAPTER XXI.

The Zinc-glue Bandage 182

CHAPTER XXII.

PAGE
Treatment of the Complications Associated with Varices 186

CHAPTER XXIII.

Elephantiasis 192

CHAPTER XXIV.

Hemorrhoids 197

Bibliography 199

ILLUSTRATIONS

FIG. PAGE

1. Superficial venous system of the lower extremity, anterior and and posterior view ..... Facing 14
2. Histology of normal vein 16
3. Embryology of valves 19
4. Embryology—development of a bicuspid venous valve 20
5. Embryology—segments of vena saphena magna and vena saphena parva 22, 23
6. Trendelenburg's states 44
7. X-ray demonstration of venous flow in varicose veins. Injection of lipiodol at mid-thigh 46
8. X-ray demonstration—lipiodol shown moving downward 47
9. X-ray demonstration—exertion forces lipiodol into varicosities of calf of leg 48
10. X-ray demonstration—lipiodol scattered and mostly disappeared. 49
11. X-ray demonstration—lipiodol has disappeared, supposedly aspirated into deep system 50

11a. X-ray demonstration—composite drawing 51

12. Eczematoid ringworm 55
13. Association of valves and reflux flow in varicose veins, complete loss of valve function 59
14. Association of varicose veins with ulcer formation 63
15. Association of varicose veins with ulcer formation 64
16. Graph of questionaire report 81
17. Armamentarium 97
18. Insertion of needle into vein 99

18a. Proper point of needle (magnified) 99

19. Composite graph of blood and urine findings after injection 111
20. Varicose veins before and after injection treatment 127
21. Varicose veins before and after injection treatment 129
22. Varicose veins before and after injection treatment 131
23. Photomicrograph of varicose veins seven days after injection treatment. Showing three different layers 137
24. Low power photomicrograph of varicose vein, sixty-three days after injection treatment 138
25. High power photomicrograph of portion of same vein shown in Fig. 24 139

FIG. PAGE
26. Autopsy specimen, twenty-one days after injection, death occurring from coincident coronary sclerosis 142
27. Autopsy specimen. Same case as Fig. 26, limitation of corrosive action of injected fluid 143
28. Autopsy specimen. Showing sclerosis and contraction of vein wall 144
29. Autopsy specimen. Veins filled with thrombi which show organization 144
30. Autopsy section. Varicose vein injected with calorose five days before death from coincident cardiac exit 145
31. Varicose ulcers before and after treatment 157
32. Ulcer of 27 years' duration, before and after treatment 158, 159
33. Varicose ulcers before and after treatment 160, 161
34. Varicose ulcers before and after treatment 163
35. Elephantiasis before and after treatment 194, 195

CHAPTER I.

ANATOMY.

The word "varicose" is derived from the Latin "varicosus," meaning dilated, and when applied to veins means those knot-like, cylindrical, or sac shaped enlargements of the lumen of the vein in the course of its distribution.

The words varix or varicose may be applied to arteries or to veins in any portion of the body; however, due to common usage they have come to be associated only with the condition of varicose or dilated veins of the lower extremities. At times it is difficult to draw a line distinguishing between these phlebectasias on the one hand and the angiomas on the other.

Classification.—The author prefers the classification according to Sabrazes.[1] He classifies the veins according to their anatomical structure:

Group 1. The fibrous veins like the dorsal and the meningeal. These do not need a supporting wall and do not need to be elastic, inasmuch as the amount of blood is more or less constant in them and their walls are supported by the bony cap of the skull.

Group 2. The fibro-elastic veins. All these veins continue the fibrous tissue of group 1 plus elastic tissue. They are the radial, subclavian, jugular, etc. These need the quality of dilating and again contracting, and yet do not need the strong support to their walls needed in other sections of the body.

Group 3. The fibro-elastic vein plus the addition of muscle fibers. Illustrative of this type of veins are such as the femoral, saphenous, mesenteric, etc. All these veins must counteract and support blood-pressure, much more so than groups one and two.

Bernstein[2] classifies the varicose veins according to the pathological formation present or the types of varices:

1. The isolated or saccular varix. It is usually present on the main trunk of the saphenous magna in the thigh.

2. The serpentine or sinuous varix. These two forms are encountered at the same time on the principal trunk of the saphenous and the collaterals. In the initial stage they often appear as a combination of types one and three.

3. The varix of uniform dilatation. One may call it the normal vein interposed between two varicosed parts of the vein yet where the wall is hypertrophied on account of the abnormal pressure due to the true varices on both sides. This is seen on all parts of the thigh and lower leg.

4. Fine cutaneous dilatations often forming "stars" or "brushes." These are most commonly seen on the inner thigh of fleshy individuals. They are similar to what the author calls "skyrocket" or "spider bursts."

Rudolph Virchow gives us a very simple classification which is also according to the pathological type:

1. Simple ectasia with uniform dilatation.

2. Varicose ectasia.
3. Ampullar ectasia.
4. Dissecting ectasia.
5. Cavernous ectasia.

This classification agrees and compares very well with that of Bernstein, yet I believe the latter is more clear and definite.

Any discussion of varicose veins must of necessity consider their size or diameter as well as their type or location. As far as the author has been able to find there has been no attempt made to establish this gradation.

In accordance with the above idea he has suggested that all varicose veins be grouped into four main classes with a fifth group which would include all others than these four. His grouping is as follows:

Size 1. Veins ½ centimeter in diameter.
Size 2. Veins ½ to 1 centimeter in diameter.
Size 3. Veins 1 to 1½ centimeters in diameter.
Size 4. Veins 1½ to 2 centimeters in diameter.
Size 5. Varices above size 4 are in reality no longer "veins" but are mere saccules of blood and need a definite description as to their size and shape.

The above classification or grouping of varices should make discussions of this subject much more clear and easily understood and will be used throughout this monograph.

The venous system of the lower leg consists of the superficial and deep portions. The deep veins of the lower leg are those situated deeply among the tissues, muscles and bones, and collect the blood from the deeper tissues about the foot and ankle, carrying it upward, and then become the popliteal vein at the lower edge of the popliteal space. This vein continues as the popliteal until it enters Hunter's canal, where it is called the femoral. It is then called the femoral vein until it passes under Poupart's ligament, at which place it becomes the external iliac, and later at the brim of the true pelvis unites with the internal iliac to form the common iliac vein.

The superficial venous system of the lower leg consists of the greater, long, or saphenous magna; and the short, lesser or saphenous parva (Fig. 1). The long saphenous forms over the inner side of the foot and ankle, passes upward just internal to the edge of the tibia, past the internal condyle of the femur, then along the inner side of the lower thigh, and on upward joining the femoral vein of the deep system through the ostial window, two inches below Poupart's ligament.

The short saphenous collects the blood from the back and external border of the foot and the back of the calf. It joins the popliteal vein in the upper edge of the popliteal space. Both these systems are extensively connected one with the other by collateral anastomosing veins. They make an extensive network over the whole lower leg, resting in the superficial fascia.

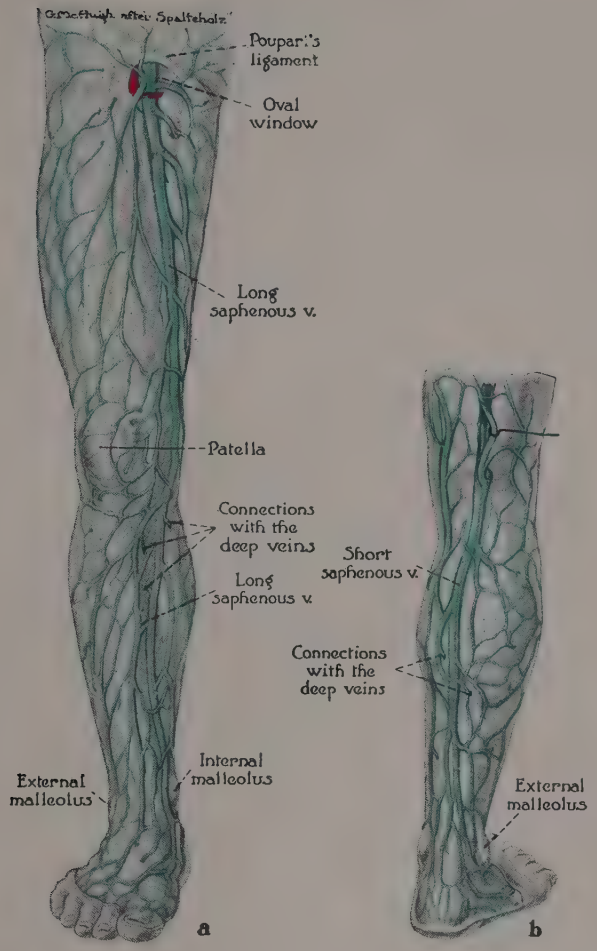


Fig. 1.

Superficial venous system of the lower extremity. *a*, Anterior view. *b*, Posterior view. Both of these figures show the extensive communicating and branching of the superficial veins and easily explain the new formation of varicosities following the removal or obliteration of varicose segments here and there. Note the communicating veins throughout.

The superficial veins are in turn connected with the deep veins both in the lower leg and thigh by communicating veins. In most of the cadaver specimens there were two communicating branches in the middle and lower thigh, though in some there were none. In the lower leg, however, the communicating branches were very frequent and scattered. All these veins, both the superficial and the deep, as well as the communicating branches, are supplied with valves with their cusps facing upward and inward, which tend to prevent the reflux of blood and to maintain the blood column above them. As a rule the valves in the vein are supplied and placed in relation to the opening of a tributary vein. Usually they are distal to it.

The valves usually are of the bicuspid type, though many unicuspid valves and occasional tricuspid groups are seen. Seventy-three per cent. of the valves in the femoral vein are bicuspid, as are also most of those in the deep veins of the lower leg.

Along the main trunk of the saphenous magna, both in the thigh and lower leg there are often found small, normal veins lying close to and often parallel with a varicosed vein. This anatomical fact explains the occurrence, often seen in practice, that we may carefully excise or sclerose a vein and yet in a year or so find another vein present in the same location. This will be discussed more fully in a later chapter.

Preparatory to writing this chapter, the author reviewed the anatomy of the venous system of the

lower extremities of thirty-two cadavers during the course of class dissection in the department of anatomy of the University of Minnesota.

Microscopic anatomy of the normal veins is well shown in the accompanying plate from Stohr-Lewis Histology (Fig. 2). This shows the layers of cuboi-

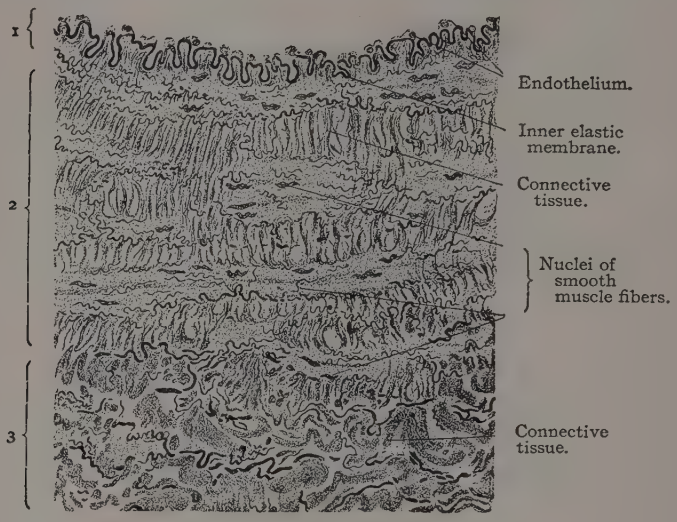


Fig. 2.

Part of a cross section of a vein from a human limb. × 230. The elastic elements are drawn very black. 1, interna; 2, media; 3, externa. The middle of the three objects labeled nuclei of smooth muscle is apparently an elastic fiber. (Stohr-Lewis, Histology, P. Blakiston's Son & Co.)

dal epithelium lining the inner wall of the vein with the elastica interna just beneath it. Below this is seen the media with large amounts of muscle tissue interspersed with fibrous tissue. The media forms the large part of the vein wall. Elastic fibers are also

scattered throughout these layers. Beneath this is seen the tunica adventitia or the outer layer of the vein wall which consists almost entirely of fibrous elements and only a small amount of muscle tissue. The muscle fibers run both longitudinally and circularly, while the elastic connective tissue fibers run longitudinally, circularly and obliquely. Through the media and adventitia may be seen the vasa vasorum of the vein wall.

CHAPTER II.

EMBRYOLOGY.

Much has been written on the embryology of the venous system but until recently there has been no definite article on the subject of the development of the valves of the saphenous system. The most able discussion on this subject is given by Drs. Otto F. Kampmeier and Carroll La Fleaur Birch[3] and this chapter is practically a review of their work.

Dr. Kampmeier's work was done mostly on the human embryo and part of it on the fetus at full term in addition to the dissection of the venous system in the adult cadaver.

The number of valves varies in all specimens and there are no constant number found for any portion of the saphenous system. Kampmeier found as a rule from six to twelve valves in the saphenous magna (Fig. 3). He constantly found a valve about 1½ to 2 centimeters above the sapheno-femoral opening and oftentimes there were two valve sets about 3 centimeters apart. This would give an average of about four to six valve sets in the saphenous magna above the knee. Below the knee in both the saphenous magna and parva they found the number varied much more than in the veins above the knee. Here as a rule, they found valves in both the saphenous magna and parva. The number below the knee in both systems varied greatly.

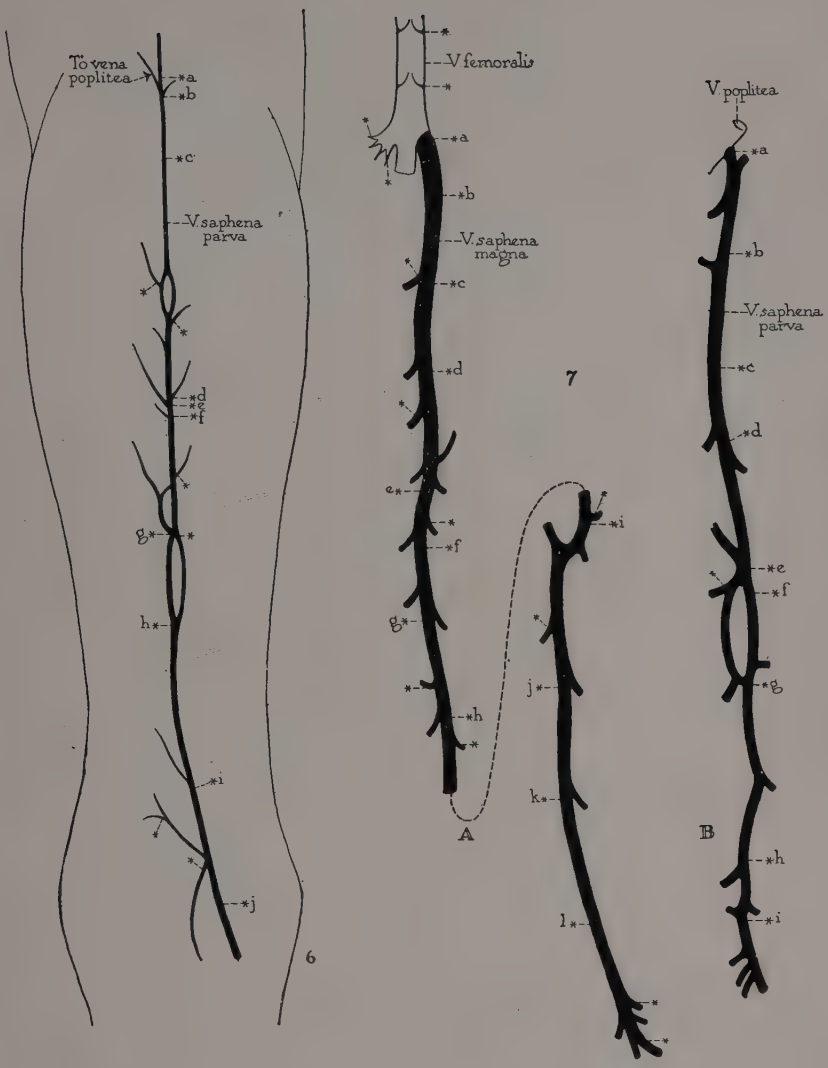


Fig. 3.

Sketch of the dissected v. saphena parva from the left leg of a 186 mm. (5.5 months) human male fetus, × 2.5. All valves (position starred) are in later stages of development. Valves *a* and *b*, and *d*, *e* and *f* follow each other in close succession in the main trunk. *A* and *B*, the same of the vv. saphena magna and parva in the left inferior extremity of a female newborn. × 2. Explanation as before.

The valves are first seen in the human embryo at the period of three and a half months development. They seem to develop in the upper saphenous magna first, so that by the fifth month all the valves are supposed to have been established.

The accompanying plates clearly demonstrate the formation of the valves. They seem to begin as a thickening of the endothelium with a ridge-like forma-

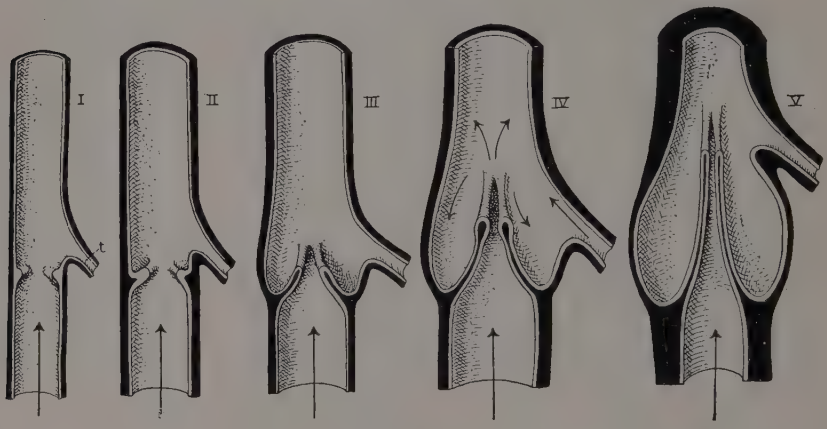


Fig. 4.

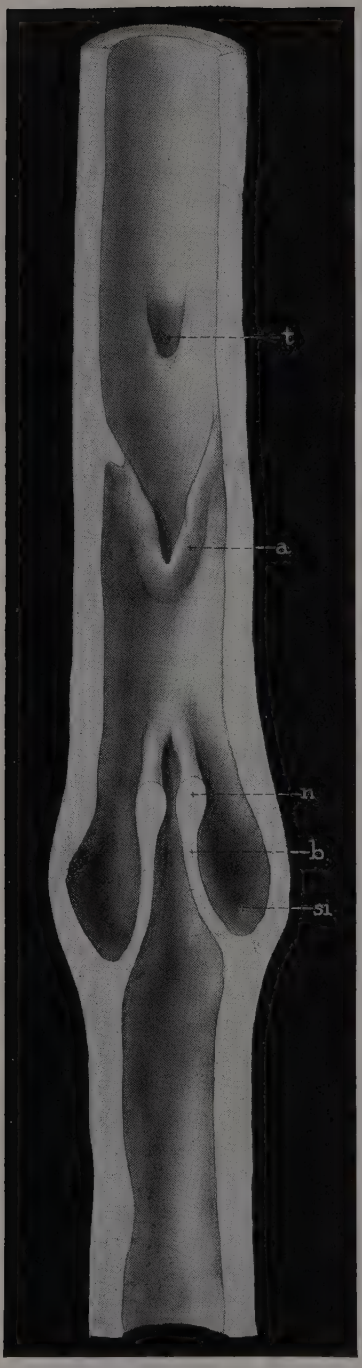
Schematic representation of the development of a bicuspid venous valve, stages I to IV, from the 3.5 to 5th month of intrauterine life. Stage V at term. Endothelial layer, white; mesenchymal layer, black; *t*, tributary.

tion on the vein wall (Fig. 4). In the bicuspid valves the two ridges are placed opposite each other in the wall of the vein, transversely to its long axis. At first they form by a mere circular ridge in the wall of the vein. This ridge is composed solely of endothelial cells to begin with, but soon the mesenchyme just beneath the ridge seems to push out

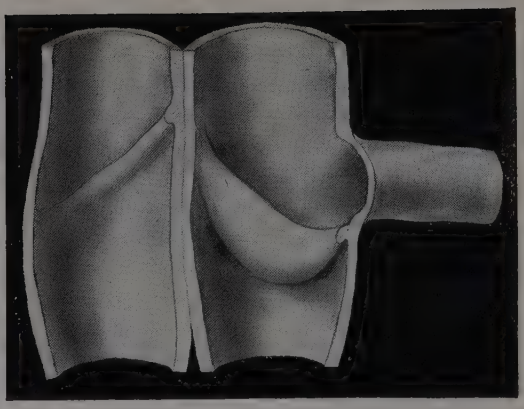
almost as fast as do the endothelial cell layers. This seems to cause a thinning of the vein wall at the base of the ridge. The base of the ridge of the bicuspid then begins to form downward as though the pressure of the fluid from above forced down the attachment to the vein wall, while the ends of the ridge or ledge were formed. This would account for the formation of the cusps of the valve. The pressure of the fluid from above the valve cusp would clearly cause the two valves to bring their ends into apposition, thus closing the lumen of the vessel. In this process it is seen how the valve comes to consist of a layer of mesenchymal cells covered by a layer of endothelial cells.

The tunica media above the valve flap is only one-fifth as wide as elsewhere. The circular muscle fibers seem markedly deficient. This may be an explanation of the varices, saccular in type, which the author found in the cadaver specimens and which will be discussed in the chapter on pathology.

By far the greatest majority of the valves in the saphenous system are of the bicuspid type as are also those of the other veins of the leg (Fig. 5). Kampmeier believed that the tricuspid is only a modification of the bicuspid; two valves having been formed from one of the bicuspid type. He even considered it as though it were an error in the development of one of the bicuspid type, giving two segments instead of one on one side, with the normal valve of the bicuspid group on the other.



A

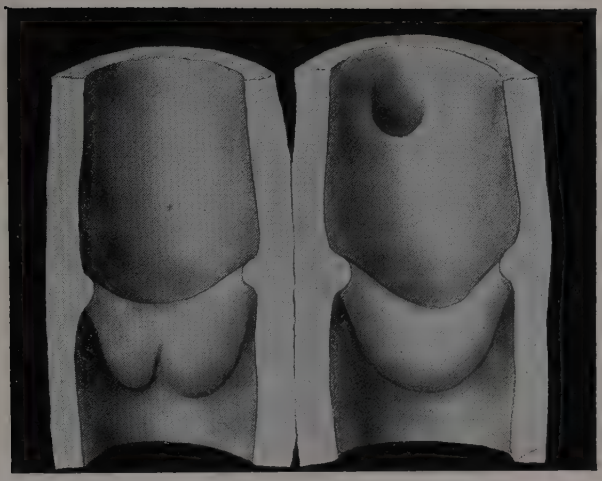


B

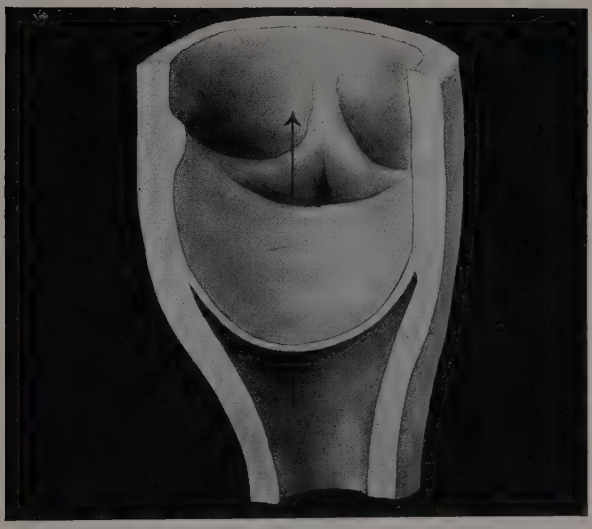
Fig. 5.

A, Reconstruction of a segment of the vena saphena magna of a 186 mm. (5.5 months) fetus, × 100, showing a perfect bicuspid valve, *b,* immediately followed (interval 150 μ) by a vestigial one, *a, t,* tributary; *si,* sinus; *n,* nodular thickening of cusps.

B, The same of the vena saphena parva of a 105 mm. (3.8 months) fetus, × 200, showing the inequality of the two cusps, one being in stage I of development, the other in stage III.



C



D

Fig. 5.

C, The same of the vena saphena parva of the 5.5 months fetus, × 100, showing the derivation of a tricuspid valve from an original bicuspid anlage.

D, The same of the vena saphena magna of a 130 mm. (4.3 months) fetus, × 133, showing a well-formed tricuspid valve.

The unicuspid valve which is often seen, but with no regularity, may be a defect in the development of the bicuspid type; thus, we have merely pouches along the side of the vein wall.

At times there are found remnants of valves which seem to be only vestigial structures located at or near the tributary vein. This would seem logical as protection against a reflux at the vein opening.

Valves are usually located at the entrance of the saphenous into the femoral and into the popliteal. They are usually to be found distal to, or below the opening of a tributary. Personally the author did not find the valves at the junction of the short saphenous and popliteal as constant as would be expected. Often there was no sign of a valve at all. At times the valves seemed to bear no relation whatsoever to the entrance of a tributary vein. Again, there were found from two to three valves along a smooth stretch of vein with no tributary veins at all. Some of the smaller branches have valves and some do not. There seems to be no regularity whatsoever in their location.

Von K. Bardeleben[4] did an enormous amount of work on the valves in the veins and their development, and he states that many more valves are laid down during fetal growth than survive to adult life. He believed that all the valves were laid down and formed by the third month of fetal life and that they soon began to degenerate and atrophy. Thus, we may see long stretches of vein with no valves at all.

Bardeleben formulated his basic law the "Klappen-

Distanz-Gesetz" in 1880, as to the location of the valves. He believed that there was a definite relation between the location of the valves in the veins and the length of the extremities in relation to the height of the whole body. He estimated that according to his law there might be 100 sets of valves in the great saphenous alone. There are many errors in his deductions however, and his theories have not been entirely accepted.

The view of Bardeleben, as to the atrophy and disappearance of many of the valves laid down in fetal growth, would agree with the theory of Klotz, that a degeneration of the valves in adult life, with a loss of their tone and a secondary gradual atrophy is one of the chief causes in the development of varicose veins.

The development of the valves seems to be associated with muscular movement, they are usually just back of and supporting the column of blood from a tributary vein. In accordance with this view we find the valves of the heart developed first and those of the femoral, popliteal, saphenous magna and parva developed later. They all, however, seem to have their development by the fifth month of gestation.

If this association and development of the valves, according to the theory of Bardeleben, is correct, why are the valves best developed during fetal life, and yet theoretically are needed most in adult life? Also why do they continue to degenerate according to the theory of Klotz[20] when they are needed most in later life?

CHAPTER III

ETIOLOGY.

Much has been written on the etiology of varicose veins and an exhaustive amount of experimental work has been done in the attempt to locate the cause of this condition. A thorough review of the literature on this subject would fill a volume by itself.

Pierre Delbet[5] has approached the subject entirely from a mechanical standpoint. As was shown in the former chapters on anatomy and embryology, all the veins are supplied with valves. According to Delbet's theory, and it is certainly most logical, the valves are placed at intervals in the veins with the idea of preventing a reverse flow of the blood distally in the extremities after it has been carried forward towards the heart. His final conclusions have been that we have a primary weakening of the valves in the external iliac veins, which allows a back pressure to develop against the valves in succession. This would occur first in the femoral at the saphenofemoral junction, and then in the superficial saphenous vein. The valves thus successively give way against this reverse pressure, and we have the vein becoming widely dilated downward throughout its entire length. According to his experience and deductions, the vein would dilate only in the degree that the valves had become deficient. This, however, we know is not

the case inasmuch as we often find segments of varicose veins below and between competent valves.

The internal or back pressure in the vein, of which Delbet spoke, is caused by any increase in the intra-abdominal pressure. This increase in the intra-abdominal pressure would occur during heavy lifting, coughing, deep expiration, or by any other condition which would cause a contraction of the abdominal muscle. This is certainly a most logical view, and can be accepted as a very positive and competent explanatory cause for the majority of cases of varicose veins. There are many cases of varicose veins, however, which this would not explain.

As was brought out in the chapter on Embryology and the development of the valves in the veins, many more valves were laid down in fetal growth, from the third to the fifth month, than survived to even the period of fetal maturity. Many of these valves continued to degenerate and were not present in the adult. This particular fact would lend much weight to the theory and explanation of Klotz, who believed that we have a progressive degeneration of the valves with age and thus consequent loss of function, allowing the reverse flow to occur. Thus a combination of the theory of Klotz, together with Delbet's theory of loss of valve function and increase of reverse pressure, would account very positively for the causation of varicose veins in the lower extremities.

Hasebroeck did a very exhaustive piece of experimental work by using a system of rubber tubes

with valves and a percussion hammer for the cardiac pulse. He arrived at the conclusion that it was the shock of the peripheric impulse forcing against the proximal side of the valve, which caused it to finally give way.

The work of Hasebroeck is very thorough in every detail and very carefully worked out yet there are many dissimilarities between his system of rubber tubes and the human anatomy, with its veins and valves, and his conclusions are thus open to severe criticism.

The theory of Magnus was similar. He suggested that the centrifugal force against the valves caused them to become deficient when the flow of blood was still in the normal direction.

Morro believes that the insufficiency of the valves first develops in the communicating veins between the superficial and the deep, thus allowing for a reflux flow from the deep system.

The dilatation of the varices, however, is not due solely to a back pressure as a result of defective valves, as is very clearly proven by the experimental work of Zancani, Fischer, and Schmeiden. All these men anastomosed segments of the saphenous vein into the femoral artery, or anastomosed the femoral artery directly into the femoral vein, and much to their surprise they rarely got the dilatation of the veins of the saphenous system which they had expected to occur. The carotid artery was also anastomosed into the external jugular and yet no varicosed condition de-

veloped. On all of these experimental animals, which were watched to as high as 86 days postoperative, very careful observations were made, and yet in only a very small percentage were varices found to develop. This would bear positive weight and evidence against the theory of back pressure as the sole cause of the varix formation.

Lehmann[6] and Lederhose, after an extensive amount of experimental work both believed that Delbet and Hasebroeck had so many errors in their conclusion that they could not be accepted as the sole cause of this condition.

Hesse and Schaak,[21] with an immense amount of experimental material and work, found that the normal valves in the saphenous magnus stand the back pressure of 180 millimeters of mercury. They explain the formation of varicose veins on the basis of accepting the normal back pressure in the venous system due to intra-abdominal pressure acting on weakened valves. Weakening of the valves may occur secondary to many factors. There may be a congenital weakness of the valves as attested by Schumacker and Lederhose, and they cite as evidence the frequent occurrence in school girls in England. This weakness may be secondary to inflammation or to direct injury and trauma or as Klotz has brought out the natural degeneration of the valves which occurs with age.

Bier and Lehmann explain the development of varices on general connective tissue weakness of the

entire body which includes varices, varicocele, pes planus, enteroptosis, hemorrhoids, etc. The walls of the vein and their accompanying valves would be sufficient to maintain the normal pressure without difficulty, yet they would give way to the increased pressure which would be associated with heavy work, severe contracting of the abdominal muscles, coughing as in pneumonias and chronic bronchial conditions, pregnancies, etc.

Kashimura, a prominent Japanese surgeon, offers the explanation that it may not be entirely a congenital proposition but that during life there develops a loss of the nerve and muscular tone of the vein wall which allows the dilation to take place. He explains the dilatation on the theory of an increased tone at first and with secondary compensatory overgrowth, particularly of the media and intima, and with a terminal relaxation. At first there is a stimulation of the nervous sympatheticus and later a relaxation and edema with a secondary degeneration. Lending weight to this theory he states that varicose veins are very rare in Japanese in their own country. This he attributes to the fact that the Oriental people do most of their work in the sitting posture, squatting on the floor. This is very logical. It is also a fact that some of the most extensive cases of varicose veins are seen in this country in the Oriental people, who no longer sit at their work but stand for many hours of the day in their laundries, which would give them the same etiological factors present as are found among our own people.

The occurrence of varicose veins during and following pregnancy calls for an unending amount of discussion. There are many theories as regards their formation and development at that time. Lohr and Kownatski explain their formation at this period, not due to the size of the uterus, but to the dilatation of the genital collection vein with its twenty fold increase in the volume of blood in the uterus. In their opinion this would account for the tremendous increase of the compensatory back pressure in the external iliac and saphenous vein, and this is certainly logical except for the fact that varices often develop or rather start their development during the second and third month of pregnancy, and certainly the volume of blood in the uterus, due to the pregnancy, has not been increased to any material extent by that time. Very well would it explain, however, the varices of the later months of pregnancy. The fact that these varices so often completely disappear during the first one or two months following confinement, lends much weight to this theory.

Zinser and Phillips believe that lues are often the associated and causative factor in the formation of varicose veins and ulcers and in their report they try to believe that syphilis is a very active factor or causative agent in a large majority of these cases. This in the experience of the author is not so at all, and in only a few cases has he found lues as a cause of the ulcer. Professor Nobl,[8] with an extensive amount of material in Vienna, is also of the opinion

that lues is a causative factor in only a very small percentage of cases.

Trendelenburg,[7] in all of his work, presupposed insufficiency of the venous valves to be present. He suggested a primary deficient vis a tergo and a secondary abnormal centrifugal pressure.

THE INFECTION THEORY.

There is much to be said in favor of the infection theory as the principal causative factor in the development of varicose veins. This could occur either embolic and hematogenous in origin or by direct extension from localized infection in the neighboring field, such as occurs following injuries and traumas. This would be explained by the development of a low grade phlebitis and even periphlebitis but of such a low-grade type as to give no clinical symptoms whatsoever at the time, yet sufficient to initiate destructive processes in the vein wall, which later go on through a pathological course to a destruction of the muscle layer of the media and a fibrous tissue formation. This will be shown in detail in the Chapter on Pathology. Microscopic sections show that there is a destruction or degeneration of the media and the elastic fibers. They are in turn replaced by connective tissue. The whole process is that of sclerosis.

Thorel believes that this condition would start with an endophlebitis, later extending to the media of the vessel wall. Others believe that it would come

through the vasa vasorum and directly involve the media. The fact that the development of varicose veins is so definitely associated with attacks of typhoid fever, diphtheria, pellagra, influenza, bronchial infection, pelvic infections in women, etc., most certainly lends positive evidence to the theory of an infection as a primary factor in the causation and development of varicose veins.

In his experimental work and pathological sections Kownatski found an infiltration of round cells and small transitional cells in the intima and media. These he thought were midway between the state of infection and the terminal connective tissue formation. This agrees with Fischer's infection theory.

Zezas theorizes that there is a bacterial toxic and hemotoxic substance liberated during the course of a general infection of the body which would directly affect the tissues of the vein wall. He calls attention to the very common and known fact that varices are often associated with various infections such as rheumatism, scarlet fever, pneumonia, influenza, etc.

INFLAMMATORY CONDITIONS AS A CAUSE OF VARICES.

Nobl[9] believes that an inflammatory process can explain all the pathology with a primary inflammatory condition and congestion and later the sclerosing results and the formation of the fibro-sclerotic wall. During this process the vein would lose its elastic tissue, the muscle fibers would become sclerosed, and the

wall of the vein would be very susceptible to increased pressure from within. At operation, or in the cadaver, it is the common thing to find the segment of the vein just above a valve to be widely dilated and in some cases these are the only portions of the vein wall that are dilated. Microscopic sections through this stretched and distended area of vein show the pathological results of an inflammatory condition. It is logical that as the venous flow becomes stagnated it would be most slowed up just above the valves and that if infection was present in the blood stream it would be more prone to infect and involve the vein wall locally at the point of greatest stagnation. This also would be an explanation why the valves in the vein are so often destroyed, and it would be evidence that at times we get a primary destruction of the valves of the vein before we get an injury to the vein wall itself. This then agrees with the idea of Delbet, Magnus, Hasebroeck and many other investigators that an incompetency of the valves is the first thing to develop and that the pathology in the vein wall, inflammatory or otherwise, develops secondary to this condition.

THE ENDOCRINE SYSTEM IN RELATION TO VARICOSE VEINS.

Previous to this nothing has been said as regards the association of the endocrine system and the development of varicose veins. There is much evidence in favor of this definite and positive association.

Professor Sicard[10] is perhaps the most outstanding advocate of this theory, however there are many points in his explanation which are open to criticism. He speaks of the three endocrine and ovarian periods of a woman's life. The one—before puberty; the second—to the age of menopause; the third—during menopause and thereafter. He draws attention to the fact that bluish cords oftentimes develop with puberty and increase with each menstrual period until pregnancy, then rapidly increase in size and extent, and finally, associated with the menopause, they become extreme. This is often true and a woman can definitely state that from month to month, associated with her menses, her varicose veins seem to get worse.

The association of varicose veins with pregnancy fits in well with his theory; but if there was truly an absence of an endocrine secretion from the thyroid and the ovary, due to and associated with this physiological condition, we should be able to correct or stop their development by the administration of this endocrine product to the patient. This, however, has never been accomplished, although effort has been made along this line.

The spider bursts or skyrocket bursts on the thigh in women, in particular the fleshy women, occurring mostly about the menopause and the latter part of the menstrual life, is in favor of the ovarian dysfunction. This is associated with a tingling and paresthesia of the sympathetic system, which has its origin in the endocrine system and he believes it is due to the absence of some ovarian hormone.

If Sicard's theory is correct, why should we not have rapidly developing and extensive cases of varicose veins following hysterectomies, and double ovariectomies, a condition which seldom does occur? He explains that men have similar periods of endocrine function during life. One, a period to puberty or soon after; then during middle life, and then again about fifty years of age. Personally the author has been unable to find evidence associated with this theory, or point, as most of his male patients have been twenty-five to forty years of age.

Sicard states that acromegalics often have associated varicose veins, although they are far from a constant finding. Personally, the author has never seen this association occur at all.

Age and Sex.—In Bernstein's report, 75 per cent. of varicose veins occurred before the thirtieth year. In both sexes they were approximately equal up to the twentieth year; between twenty and thirty years, four women to one man; from thirty to forty years, three women to one man, and between forty and fifty years, four women to one man.

The age incidence of the patients in the author's series was as follows: Between ten and twenty years, 1 per cent.; twenty to thirty years, 18.1 per cent.; thirty to forty years, 27.5 per cent.; forty to fifty years, 24.7 per cent.; fifty to sixty years, 16.75 per cent.; sixty to seventy years, 10.8 per cent.; seventy to eighty years, 1.15 per cent. The youngest patient was nine years old and the oldest seventy-seven.

The sex relation showed a very marked preponderance of women over men. In both sexes they were apparently equal up to the twentieth year. Between twenty and thirty years, four women to one man; from thirty to forty years, three women to one man, and between forty and fifty years again, four women to one man. This unequal relation between men and women would bear direct evidence towards Sicard's theory as to the association of the ovarian and endocrine system with the development of varicose veins. The periods between twenty and thirty years would correspond to the more active period of the woman's life, and to that period during which the largest number of pregnancies occur. The period again between forty and fifty years corresponds to the menopause and many cases of varicose veins develop at or during this period, while other cases which have remained very moderate indeed throughout the woman's life to this date, rapidly develop and at times become very extensive. This unequal relation between men and women can only be explained by the association of pregnancy and the many factors which it brings into the case, together with the presence or absence of the ovarian secretion which varies with different periods of the woman's life.

In other large series approximately the same number of men as women have this affliction, yet due mainly to cosmetic reasons, more women than men present themselves for treatment. This fact has become emphasized during recent years through the

evolution of the short skirt and the tendency of modern youth and womanhood.

Heredity undoubtedly plays a more important part than has been thought heretofore. One writer cites 6 per cent., one 8 per cent., and one 10 per cent. Personally, the author found it even higher.

It was shown in the chapter on anatomy and physiology of the normal venous circulation, that the contractile effect of the muscles when walking forces the blood upward through the deep system, thus preventing the possibility of a stagnation in the deep system, or if there were varices of the superficial veins, this blood would be aspirated inward through the communicating branches and thus forced directly upward through the deep system again. In those occupations which demand that the patient stand for long hours at a time, such as barbers, clerks, etc., we would entirely lose this pumping effect of the muscular contraction and instead would have the continuous back pressure of the venous column, whatever that might be.

CHAPTER IV.

DIAGNOSIS AND DIFFERENTIAL DIAGNOSIS.

In considering the differential diagnosis of varicose veins we would think of thrombo-angiitis-obliterans, intermittent claudication, Reynaud's disease, diabetic neuritis, indurated erythema of Bazin, Morton's disease, the pains associated with flat feet and the rheumatic pains about the knee and ankle. The varicose veins which are compensatory and which develop following a deep thrombophlebitis must be differentiated from those varicose veins usually met with.

Phlebectasias occur in all ages of life, among infants, children and adults, as well as being at times congenital. For the most part, they are found in the lower extremities. They involve particularly the long and short saphenous as well as at times the deep veins of the lower leg. In addition to varices of the saphenous system we have varices of the umbilical cord, pampinaform plexus, the labia majora, the veins of the broad ligaments, rarely the veins on the arm, and Berger even reports varices in the brain. They may be present in any organ or structure of the body, the esophagus, the stomach, the intestine, the scrotum, the bladder, hemorrhoids and the abdominal wall. The latter occurs secondary to cirrhosis of the liver, or at times secondary to a deep thrombophlebitis

of the lower extremity extending upward and including the femoral vein.

Under the direct heading of varicose veins then, we must decide whether it is true abnormal varix and pathological, or whether it is a somewhat dilated and yet otherwise normal condition. This discussion, however, is limited almost entirely to varices of the veins of the lower extremities.

Under the differential diagnosis of varicose veins as the cause of pain and other symptoms we must consider any subject or disease which will cause pain or discomfort in the lower leg. Of these, rheumatism is the most common, with rheumatic pains about the knee and ankle. Oftentimes, we have the two conditions associated. One, the primary varicose vein about the knee with a secondary rheumatic infection developing. Again, we have patients who have varicose veins developing secondary to the presence of rheumatic treatment. Oftentimes, the rheumatic pains will entirely disappear following the treatment of the varicose veins.

At times the patients are brought to us primarily as rheumatic patients. Cases of arthritis of the hip are brought where the arthritic pain, as a chronic condition, may be due to varices.

By the abnormal tension on the terminal nerve filaments underlying the skin of the lower leg we can have pains which simulate most any condition of the lower leg.

We have to differentiate between a true sciatica and the sciatic type of pains due to varices, tabetic

pains in the lower leg, polyneuritic pains, pains of osteitis and periostitis developing following a coincident bruise of the tibia or the periostitis following the congestion of an associated varix which is very common. The menopausal arthritis is much discussed of late. This occurs in the fleshy type of individuals during their menopause and is apparently due to the increased weight bearing on the synovial membrane of the knee which has become less competent to support the weight during the adult years and due to the changes which have supervened with the onset of the climacteric.

We often see the beefy type of lower leg where these varices seldom occur and are of no particular importance; however, patients often come to us complaining and speaking of the few scattered varices they have as the cause of their large and unsightly legs.

The treatment of the varicose vein present, however, by the injection method will tend to make a differential diagnosis more positive.

At the time of the first visit a careful history is taken and particular attention is paid to any point that might be indicative of there having been, at sometime previous, an acute infectious thrombophlebitis, either of the superficial or of the deep system. Oftentimes the patients will misunderstand "milk leg" but if it is spoken of as associated with pregnancy they will know just what you mean. Knowing that after each attack more damage has

been done and a greater injury to the circulation has resulted, inquiry is made as to the number of these attacks. Inquiry is made as to the date of the first ulceration, how many times the ulcers have recurred and the amount of disability at various times during life. An attempt is made to determine just what the doctor or attending physician at the time of their disability thought of the condition. The patient is questioned as to the amount of edema and swelling of the feet which existed after the attack and as to how long the edema persisted. General inquiry is made as regards their past history. This is done with the possibility of finding if there is a latent diabetes, or a diabetes treated at some time previously, and also to uncover any other essential facts pertaining to the case.

The thoroughness and carefulness of a complete physical examination is determined separately with each individual patient. Some cases are gone into much more thoroughly and in more detail than others. In view of the author's opinion as regards broadening the indications for the injection treatment and the narrowing to extremely narrow limits the contra-indications for the same, he believes that the importance of a general physical examination in each and every individual case is exaggerated.

CHAPTER V.

DIRECTION OF VENOUS FLOW IN VARICOSE VEINS.

EXPERIMENTAL AND X-RAY EVIDENCE.

The very thought of injecting directly into the blood stream a destructive solution with the intention of getting a thrombus formation, which is always considered the parent of an embolus, seems unscientific and certainly non-surgical. This, however, is what is done in the injection treatment of varicose veins by the use of sclerosing solutions. This bit of experimental work was undertaken in the attempt to prove that the direction of the venous flow in varicose veins tended to prevent embolus formation rather than produce it.

Normally, all venous flow is upward both in the superficial and the deep system of veins. The deep veins scattered through the muscles of the lower leg are supported by the surrounding muscles and strong fascial layers. This prevents their walls giving way and producing varicosities. The muscular contraction of the leg in walking exerts a constricting effect on the veins of the deep system and thereby, with a pump-like action, forces the blood upward in these veins which are equipped with valves to prevent a reverse flow (Fig. 6).

The veins of the superficial group, however, have no support other than their own walls and that of

the surrounding fascia which is mostly soft adipose tissue. The fat offers but little support to the vein walls and at times practically disappears. They too are equipped with valves.

The skin, while possessing the turgor of youth does not prevent the veins from dilating in the fatty layers and becoming elongated and tortuous. In later life, even this tonicity of the skin is lost and the veins

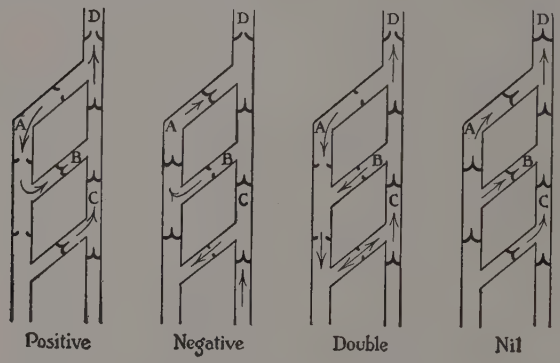


Fig. 6.

The four Trendelenburg states according to Bernstein.

often become but little more than large saccules of stagnant blood. To aid in the expulsion of blood from these veins, we have the valve plus the aspiratory effect, as described by Bernstein[2] and Hallion,[22] and the aspiratory action of the pelvic veins. Between the superficial and the deep sets of veins are the anastomosing communicating veins, likewise equipped with valves facing the direction of the deep circulation. Thus, in a normal individual it is possible for the blood to pass from the superficial veins

to the deep system, but not ordinarily in the reverse direction. If the Trendelenburg reaction is negative or double, this reverse flow from the deep to the superficial system will be possible. Whether the primary factor in the etiology here is the loss of the valve function[2] or the injury to the vein wall from infection, thus permitting it to dilate and throw extra stress on the valves in the saphenous vein, is a much debated question.

It is the author's contention that in all varicose veins and particularly in those in which the valve action has become deficient, either through a primary destructive injury to the valve or secondary to a dilatation of the vein walls, the venous blood is stagnant or flows in the reverse direction. Particularly is this true in those veins which show a positive or double Trendelenburg test with von Perthes' modification (Fig. 6).

This phenomena merely demonstrates that the valves of the saphenous vein are incompetent, as in the Trendelenburg positive; or that the valves in both the saphenous and in the communicating vein are incompetent as in the Trendelenburg double, and furthermore, that the deep saphenous system is competent and functioning.

It has been the aim to demonstrate and confirm these findings in the living subject. With the aid of the fluoroscope this has been done (Figs. 7 to 11*a*).

With the purpose in mind of corroborating or disproving these pathological findings and observations

the author injected lipiodol directly into the varicose veins of the thigh and then observed the results under the fluoroscope. It very clearly confirmed the opinion that the venous flow in varicose veins was toward the periphery, returning to the general circulation through the communicating veins and the deep system.

The idea was to determine with the aid of the fluoroscope the course taken by the injected fluid in

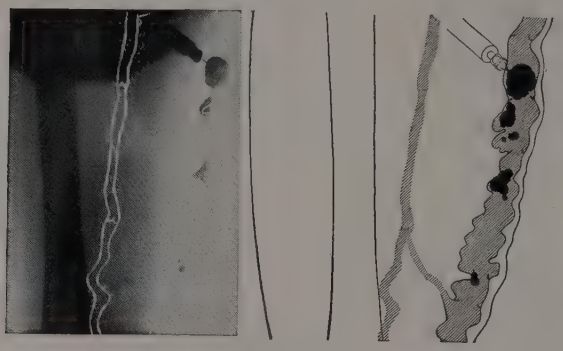


Fig. 7.

Showing the injection of lipiodol into varicose loops of great saphenous at mid-thigh. The first half cubic centimeter has already passed downward toward the knee. The small white lines represent schematically the veins of the deep system.

the saphenous veins. One cubic centimeter of lipiodol was injected into the upper limit of the varicosed saphenous vein, and its progress was then observed under the fluoroscope, taking X-ray exposures at various stages. Upon the X-ray plates, the saphenous vein has been diagrammatically sketched in order to be more illustrative.

The experiment was done on two patients, with more success and better plates on the second case.

It is the X-ray plates of case No. 2 which the artist has attempted to reproduce by her drawings, making more clear the point in question.

Case report No. 2. Mrs. H. F., age 40, had large varicose veins (size 4) extending from her groin to the ankle in a continuous tortuous mass of varicosities. The circulatory test gave a Trendelenburg positive with von Perthes' modification. The

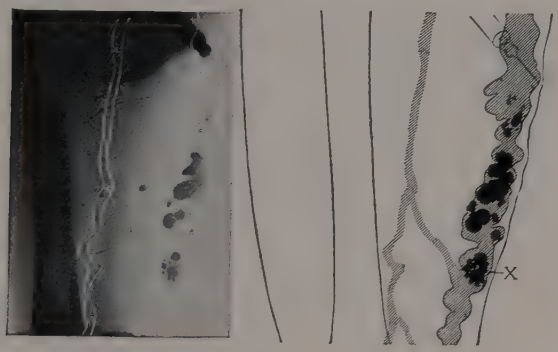


Fig. 8.

The lipiodol is shown moving downward following exertion. The lipiodol at point × seemed to be caught in an aneurysmal sac and remained there as described.

patient was placed upon the fluoroscope table in the sitting position, with her legs extended horizontally. One-half cubic centimeter lipiodol was injected into a large loop of vein in the upper third of the thigh and its progress observed under the fluoroscope, taking pictures at opportune intervals.

As long as the patient remained perfectly quiet, the lipiodol remained in a solid mass about the point of the needle. She was then asked to strain as at

stool, producing a definite increase in intra-abdominal pressure. The globules of lipiodol passed downward about six inches. Relaxation caused no reflux. Further straining scattered the globules and forced them farther peripheralward. One cubic centimeter more of lipiodol was injected and the same procedure produced similar results (Fig. 7). Muscular activity of the foot without force caused the particles of lipi-

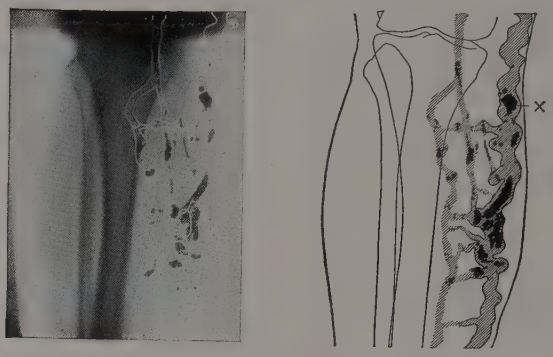


Fig. 9.

Following repeated straining and exercise lipiodol was forced downward into the varicosities of the calf, breaking into minute globules.

odol to pass downward into the veins of the leg and into the communicating veins, where they were seen to swirl around in aimless fashion (Fig. 8). One particle appeared to be caught in an aneurysmal sac, for it remained twirling constantly in one place, as seen in all the plates in the mid-thigh (Fig. 8, x). Forceful exercise of the calf muscles, pushing against the resistant hand of the examiner, thus simulating the action of walking, caused the particles to pass into the deep system, where they advanced toward the

heart with each pump-like action of the leg (Figs. 9, 10 and 11).

During inspiration, the globules in the superficial varicosed saphenous veins were forced peripheralward about one inch. Those globules in the deep system remained stationary. This was the effect of intra-abdominal pressure upon the valveless saphenous. Expiration with its negative intra-abdominal pressure

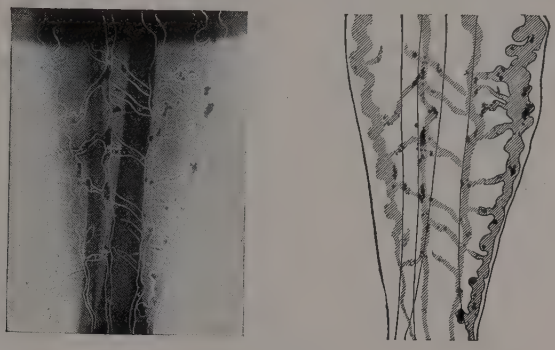


Fig. 10.

Shows the lipiodol scattered widely and mostly disappeared.

produced no change in the superficial varicosed saphenous, but due to the aspiratory effect, tended to draw the particles centralward from the deep system of veins. With repeated expirations, we were able to aspirate the particles of lipiodol further centralward through the deep system of veins, but this had no effect upon the particles of lipiodol in the superficial veins.

The author believes that the greater volume in the varicose veins is not influenced during expiration by the aspiratory effect within the abdomen. The

blood, therefore, follows the path of least resistance and passes downward through the communicating into the deep veins and then centralward, where the physiologic factors are more normal.

The author also believes that these experiments demonstrate and confirm the findings of Bernstein, which he obtained through extensive operative work

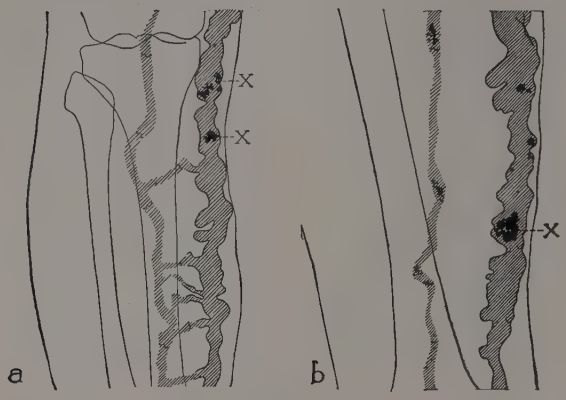


Fig. 11.

Shows all the lipiodol having disappeared and supposedly aspirated through the communicating veins into the deep system except for the small amount caught in the aneurysmal sacs at the points marked ×.

in the surgical treatment of varicose veins, to be as follows:

1. In the early cases of varicose veins of the legs, the valves in the saphenous may be competent and there is no reverse flow. In these, there is merely a stagnation of blood. These demonstrate the Trendelenburg *nil.*

2. In the moderately advanced cases, the valves have become deficient and the Trendelenburg test is

positive, with the blood flowing downward in the superficial saphenous and into the deep veins through the communicating veins, the valves of which are still normal.

3. In the advanced cases, the valves in the com-

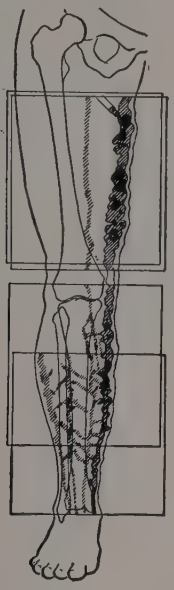


Fig. 11*a*.
A composite drawing showing all plates together.

municating veins are also destroyed and thus a Trendelenburg double is developed.

This explains clearly how valvular incompetency in the great saphenous (Trendelenburg positive) plus the valvular deficiency in the communicating veins (Trendelenburg negative) gives the condition described as Trendelenburg double. In this condition, we get a reverse flow from both the superficial and

deep system of veins, causing a stagnation of blood in the dependant extremity with a saturation of the tissues by blood serum. It is this saturation of the tissues that lowers their resistance and makes them so susceptible to infections and later to ulcer formation, the dreaded end result of varicose veins.

In all varicose veins of the lower extremities, the circulation is either stagnant or reverse. An embolus, if formed from the chemically induced thrombus, is forced distally toward the smaller and branching veins, where it would most certainly be arrested.

Until some more definite reason can be found to account for the rare development of emboli, this explanation of their unusual occurrence must be accepted.

CHAPTER VI.

THE COMPLICATIONS ASSOCIATED WITH VARICES.

The most common complication associated with the development of varices is the development of an infectious thrombophlebitis. This occurs in the superficial group of veins, the saphenous magna and parva, and in the deep group of veins of the lower leg.

The presence of the large varices in the superficial system predisposes toward the development of a thrombophlebitis of the deep system and a deep thrombophlebitis is thus more liable to develop with large varices of the superficial system present than otherwise. As was shown in Chapter V, on the lipiodol and X-ray demonstration of the direction of the venous flow, it was clearly seen that the blood in the large dilated varices of the superficial system is either stagnated or flows in the reverse direction. This blood naturally is more poorly oxygenated than any other blood in the system and is consequently more susceptible to infection. It is certainly logical that these large saccules of blood would form perfect areas of lowered resistance for infections to develop from some distant foci of infection. Thus violent, acute, inflammatory conditions develop in these large sacculated loops of veins. The condition is very painful and tender. The vein becomes filled with a hard clot or thrombus.

Seldom is this infection of such a severe nature as to break down and form an abscess, though oftentimes it will extend up and down the vein involving the varices for several inches. The veins become very painful, swollen and tender. At times the tissues about become indurated with an intense cellulitis. The condition is very slow to recover and is very prone to extend. In fact we often see the infection extend from one segment to another just as it is about cleared up in the first. It is not only prone to extend to other segments of the superficial system of the thigh and lower leg but also to the varices of the other leg if they are present.

It is not unusual to find this condition develop in the superficial system first and later extend to the deep system. It is so prone to spread from one segment to another that Vaquez has called it a venous septicemia or the "migrating" type of infectious thrombophlebitis

An acute thrombophlebitis of the deep system of the lower leg oftentimes develops even though there are no large varices of the superficial system. Because this has so often developed, associated with confinement, the laity have always considered that there was a definite relation between the two. This condition would often develop co-incident with the filling and engorgement of the breasts on the fourth to fifth day post partum. Years ago the mid-wives called this condition "milk leg" because of its close relation and association in period of time to filling and

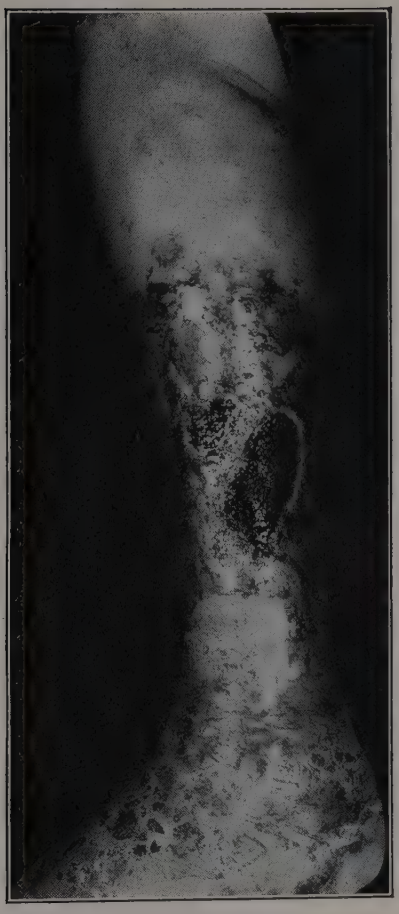


Fig. 12.

Eczematoid ringworm in foot associated with ulceration

engorgement of the breasts with milk. They thought that the leg became filled with milk as accounting for the swollen, congested, white, tender appearance. This condition develops more often during the first few days post partum than at any other time. It often develops following pelvic operations in women, general, systemic, infectious conditions, such as pneumonia, influenza, etc., in both male and female.

Following the marked inflammatory condition of the leg associated with the development of the acute thrombophlebitis of both the superficial and the deep set of veins there is a marked destruction and injury to the lymphatic circulation of the leg and in particular the lymphatic circulation of the superficial fascia. There is always a varying amount of edema of the tissues both below and about the area of this thrombophlebitis. At times it persists for a long time and then again clears up rapidly.

The continued congestion of the skin associated with the presence of varices at times causes a very intense dermatitis, and later on an eczema, which may be of the most extensive, moist and oozing type. Ringworm of the foot, the fungus infection similar to what Strickler[11] calls eczematoid ringworm and caused by the epidermophyton fungus is often associated with this (Fig. 12). This begins in the tough cornified skin near the sole of the foot and between the toes. At times the skin of the whole foot will form large, very tender, painful blebs filled with a translucent fluid. In extreme cases the tough skin

becomes whitened and macerated and will peel off in large areas leaving a secondary infected base. This condition at times is very resistant and must be treated very persistently and stringently in order to secure results. It is very prone to recur.

The condition called hemorrhagic varices is but little described in the literature, though often seen. In this condition the varices seem to be very thin walled, and following very light trauma or oftentimes no trauma at all, the varix will actually rupture, giving much diffusion of the blood in the superficial fascia. At times the patients will present themselves with these large black and blue spots of the recent hemorrhage over the whole thigh. These seem to occur more in those who are very fair skinned, and more over the thigh than the lower leg; more externally over the thigh than internally. This also occurs more often in the smaller type of vein than in the large ones. The patients often describe a feeling of burning or pricking in the skin, and soon thereafter will be surprised to see the ecchymosis spread about that area.

The most severe and extreme condition which develops as a complication associated with varicose veins is ulcer cruris, or varicose ulcer. This will be taken up in detail in a chapter by itself.

CHAPTER VII.

ULCER CRURIS.

Ulcer cruris or the more commonly known varicose ulcer may be one of the most severe and disabling conditions of the lower extremity. Individuals so afflicted are truly "victims," and even though healing is successful they must endure their disability for the rest of their lives with a fear of a recurrence of the ulceration.

The etiology is now very generally accepted to be a trophoneurotic disturbance and condition resulting secondarily to the development of varicose veins. It is the varicose veins with the reverse flow, and the resultant stagnation of fluid in the tissues in the extreme cases, which is the basic factor producing the lowering of the tissue resistance and the secondary ulceration.[1 2] Thus, the basic etiology of varicose ulcers is that of varicose veins, which was discussed in detail in the first chapter. As the result of various causes of varicose veins, which I have discussed; sooner or later the difference in pressure between the blood in the veins and the fluid in the tissues is equalized. Then by the process of stasis, the tissues become water-logged, and their resistance to infection or trauma becomes lowered because of impaired nutrition. As a result an ideal condition for the development of the varicose ulcer is produced.

Figure 13 is self explanatory of this condition, as it shows complete loss of valve function in the superficial and communicating veins, and the association of venous blood with the tissues saturation.

The immediate cause of the tissue breakdown is often trivial. It may be embolic and due to infected

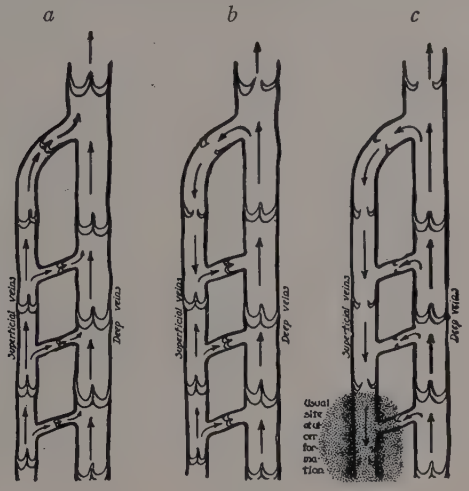


Fig. 13.

a, Normal flow in superficial and deep veins; *b*, beginning reflux flow in the superficial veins; *c*, complete loss of valve function in superficial and communicating veins.

teeth, tonsils, hemorrhoids, etc., or, as frequently happens, it may result from light trauma and terminate in local necrosis. If not cared for, the affected veins may increase in size and number, the congestion may increase, the ulcer may penetrate deeper, and may result in a painful periostitis of the tibia. However, the process may be limited and cured by prompt, efficient treatment, although the ulcer cycle always

causes much damage to the circulation and nutrition of the tissues and leaves the tissues far more susceptible to ulceration. Ultimately, following years of ulceration and healing, the tissues become so indurated that a continuous potential state of gangrene exists and ulceration can be prevented only with continuous supervision and care. Ulcers developing in this field are truly trophic and may no longer be due to varicose veins.

The actual ulceration begins with a gangrene and separation of the superficial layers of the skin. At times the area takes on the typical appearance of a carbuncle, while in other cases, as a result of a long-standing condition, the ulceration extends through all of the dermal layers. In some cases the whole lower leg has the appearance of an extensive, far advanced, weeping eczema.

Microscopic sections through the ulceration demonstrate that the pathology is largely in the skin and that there is only an inflammatory reaction of the tissue beneath.

Bacteriological examination of the ulcers has proved that there is no constant organism that may be held as a specific cause. The staphylococcus and streptococcus are found in all cases and are usually associated with other organisms. In no instance, regardless of the severity of the case, has the gas bacillus or bacillus of gangrene been found. Professor Gabor Nobl[13] states that he does not believe that there is any relation between the type of infec-

tion or bacteria in the ulcerating area and the slowness or rapidity with which the ulcer heals. His opinion was confirmed by the extensive work of Lowenfeld[14] on the "Bacteriology of Varicose Ulcers," which shows that those ulcers which heal most rapidly often contain the most bacteria.

Differential Diagnosis.—In discussing the differential diagnosis of varicose ulcers we must consider the syphilitic, the tuberculous, the rodent (malignant), and the rarer forms of ulcerating conditions of which the most common would be actinomycosis.

1. Varicose ulcers are by far the most common ulcerating condition of the lower extremities and are of all sizes, shapes and conditions. Associated with the ulcer there is usually a well marked area of inflammatory reaction, which at times will spread for several inches beyond the open ulcer. The ulcer as well as the surrounding tissues may be very tender. The edges are usually sloping in appearance and the base is ordinarily covered with large coarse granulations and a greyish exudate. The discharge may be very profuse.

As already stated the dilated varicose veins with their reflux flow and accompanying congestion are accepted as being the cause of the varicose ulcer. One can nearly always find these large venous channels about the ulcerating area.

2. The syphilitic ulcer usually has punched out, sharply defined edges which at times are raised. It is ordinarily deeper than ulcers arising from other

causes. The base is dark red and has large granulations, which may be unusually large in the larger ulcers and may bleed very readily. Much serum exudes from the surface but this does not give the impression of being pus. Luetic ulcers may assume any shape or condition. In addition to the clinical appearance, a positive Wassermann is present and often a history of the original infection obtained.

3. The tuberculous ulcer is uncommon on the lower extremities. The edges are usually undermined. Some authors state it has a tendency to progress with an irregular border outline giving the impression at times of a half circle, but this is not a tuberculosis characteristic. The base is seldom red and granulating as in the luetic ulcer, but more frequently is covered with a grayish necrotic exudate. It is thought that the tuberculous ulcer is always secondary to tuberculosis elsewhere. An active tuberculosis would of course be a definite diagnostic sign.

4. The rodent or malignant ulcers are infrequent on the lower extremities although common elsewhere. They are found in older patients and do not have the local inflammatory reaction which is seen with varicose ulcers. There would be no varicose veins except as a coincidence and there would be no response to the usual treatment. With a negative Wassermann, with no symptoms or signs of tuberculosis, and with no response to the usual ulcer treatment, a biopsy should be made to confirm the diagnosis.

5. Trophic ulcers can usually be diagnosed without difficulty after consideration of the clinical history of the case.

6. The actinomycotic ulcer starts as a nodule, subsequently breaking down, leaving a necrotic base with scattered yellowish nodules. This type of ulcer is very rare and is seldom seen except in hide-handlers, etc. The diagnosis would be suspected when cure

Fig. 14.

Shows the association of varicose veins with ulcer formation.

had resisted all treatment. Curettings should be made from the ulcer base with examinations for the ray fungus.

The close association of the varicose veins with actual ulcer development has never been emphasized as much as it should. Many authors do not bring out this point at all. In addition to the general congestion of the ulcer region, as has been discussed, we will often find one or more large varices extending directly into, or under the ulcer area (Figs. 14 and

15). Oftentimes there is an area of extensive ulceration with a moderate ulceration extending further. The cellulitis about this whole region is so intense, that one may be unable to locate the soft vein fluid, yet experience has proven that the varix will be leading directly into this area of cellulitis, and continually keeping the saturation of the tissues going on. This

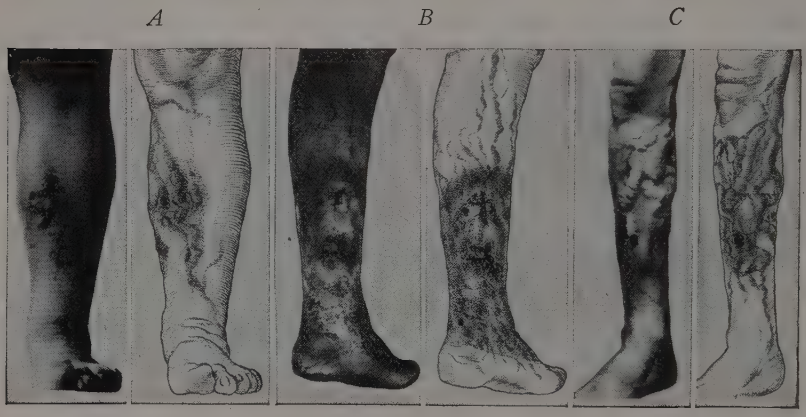


Fig. 15.

A, B, C, Showing the intimate relation of veins to the ulcer. In *B* is shown a fungus infection of eczematoid ringworm on the foot and leg which often complicates the ulceration.

feeder vein, as it might be termed, usually comes from above, but may be present as a reverse flow coming upward from the ankle and sometimes from both sides.

In other ulcers we are unable to locate this vein until after the ulcer has healed, and then we will find the vein as large as a lead pencil or larger, directly under and in the base of the old ulcer. In some of these cases we often find the only varix present is

that portion of varicose vein directly involved in the ulcer bed.

Many men have associated the calcium imbalance of the body with ulcer formation. In some cases there is a definite association between these two. This has been estimated by checking the blood calcium both before and after treatment.

As stated at the beginning of this chapter varicose ulcers are very painful. At times they are so painful that the patient is absolutely forced to his bed. There has been much interesting discussion as to the cause of this pain, but it seems quite clear to the author. It must be remembered that the terminal nerve filaments which supply the ulcer area or the skin area are not broken down into the ulcer formation but are held under pressure in this area of cellulitis and congestion of the tissues. The terminal endings of the nerves are also acutely eroded and inflamed, and thus, hypersensitive and more easily pick up sensations stimulating them. When a patient is on his feet the reverse flow of blood in the varices is increased, the congestion of the tissues with fluid stagnation is increased, and consequently, the pressure on these fine, terminal, inflamed elements or endings is increased, and this well explains the cause of the pain in varicose ulcers, and also why the pain is relieved when the patient goes to bed with high elevation of the leg. It also explains the relief of pain following the rubber sponge treatment, which will be discussed in detail in another chapter.

CHAPTER VIII.

TREATMENT IN GENERAL.

When we consider the treatment of varicose veins, or any of their complications, we must consider the normal physiology of the circulation of the superficial venous system of the lower extremities, as a primary consideration. This is of first importance inasmuch as it is the pathological development which takes place in the superficial venous system, as well as the deep system of veins, which is accepted as the cause of the ulceration, eczemas, etc. This was taken up in detail in the chapter on anatomy and physiology of the venous system.

As was shown in that chapter the normal circulation in the venous system is naturally from the extremity toward the heart, in a proximal direction, both in the superficial and deep veins. This circulation is aided by the negative pressure within the abdomen during the period of expiration, and by the natural supportive effect of the tissues about the veins, giving a support or pressure against their walls.

This is true in particular of the veins of the deep system of the lower leg; where we have the walls of the veins compressed by the muscles during their periods of contraction in walking. The contraction of the muscles when walking forces the blood upward through the veins toward the heart with a

pump-like action, and it is the purpose of the valves to retain the blood above them, similar to the valves in a pump, while the vein fills from below.

In the chapter on etiology we discussed all the different theories as to the causation of varicose veins, and in treatment we must consider them again.

If, in the particular case in hand, we believe there is a large endocrine factor, then we naturally would try and correct the endocrine pathology by feeding this substance. Some men insist, on the contrary, that there is an over production of sex hormone associated with pregnancy and that this is the causative agent. As yet, the endocrine factor is much debated and unsettled.

The fitting of proper shoes is a very essential point in all cases. Some authors attach great significance to the association of flat feet and fallen arches, and believe in correction of this disability before active treatment of the varicose veins themselves is begun. However, correctly fitting shoes should be prescribed in all cases. All constrictions about the leg, which would tend to constrict the normal flow of blood, such as tight garters, tight bloomer bands, etc., naturally must be forbidden.

It is very logical that there is a continued and repeated increase in the abdominal pressure, according to the theory of Hasebroeck, associated with the severe coughing of chronic bronchitis, bronchiectasis, and other pulmonary conditions. This would increase the back pressure against the sapheno-femoral valve and

cause it to give way with the resultant varix formation as explained by Delbet and Mocquot. Therefore on this basis all measures should be taken to correct all chest conditions present, with their continuous and at times severe coughing.

Tumors of the pelvis should be taken care of operatively, or otherwise, as the condition indicates.

If there is any condition present in a person's habits or occupations which would tend to increase and aggravate the pressure in the venous system of the lower leg, naturally, this should be corrected. Inasmuch as standing long hours at a time in one position, very definitely increases the venous pressure by stasis alone, it is urgently advised that patients such as these stop their work at intervals and take a few steps about, thus emptying the venous channels in the lower leg of their congestion. The individual running the power machine with one foot oftentimes develops the varices in the leg on which they stand and not in the extremity with which they run the machine. They should accustom themselves to running the power machine with either foot. Efforts should be made to relieve constipation.

Until very recent years all attempts at the care or treatment of varicose veins has been aimed at the pathology in the venous circulation. Most of these efforts have been by means of surgical measures. All patients, however, would not accept surgery. There are certain types of patients in whom any type of treatment either operative, injection, or otherwise,

other than mere palliative, is contraindicated and naturally these patients should have the supportive care, even though it be only palliative.

The usual palliative treatment which has been advised has been the wearing of elastic stockings or elastic bandages of some type or other. The purpose of these, of course, is merely to give support to the dilated varices, mechanically holding their walls collapsed or at least compressed to the normal size. Oftentimes under this treatment the vein walls do seem to regain their tone and for at least a part of the time the patient can get along without bandages. This is very true indeed of the varices which occur during pregnancy. Here the patient can be made very comfortable in practically all cases by the wearing of these external supports and in the great majority of cases the varices themselves seem to clear up and disappear during the first few months following confinement.

Acute thrombophlebitis, infectious in nature, has always been treated strictly palliatively in the past. This must still be treated with palliative measures even though there are men[24] who advise radical resection of the thrombophlebitic vein if only the saphenous group in the thigh be involved. This, however, is such a radical procedure that in the opinion of the author it is contraindicated. In the past these patients have been put to bed with rest, elevation of the extremity and hot wet packs to the area involved. This is still the accepted and best treatment for acute

infectious thrombophlebitis of the large varices of the thigh. The condition, however, in the varices of the lower leg is best treated by other and more radical measures as will be discussed later on. Treatment of other complications will be taken up in detail in their order.

CHAPTER IX.

THE OPERATIVE TREATMENT.

As has been stated the operative treatment[46] of varicose veins has been the sole effort, with a few exceptions, of attempting to correct the circulatory condition present in the lower extremity. This has been based primarily on the assumption that we have the reverse flow in the venous system due to the deficient valves at the sapheno-femoral junction.

The Trendelenburg and Other Technic.—Trendelenburg was one of the early surgeons who attempted this work. He was so thorough in working out the pathology present and in testing the circulatory system that his test has since been known as the Trendelenburg test, and today the Trendelenburg test, with its various modifications, is accepted as the one test or group of tests which must be applied before any operative treatment, in any form, is attempted. This surgeon merely attempted, under local anesthesia, to ligate a section of the saphenous vein 10 to 15 centimeters below the sapheno-femoral opening, resecting a short segment of vein between his ligatures. Inasmuch as he reasoned that the condition present was due to a reverse circulation and a backward flow of blood through the sapheno-femoral opening, it was logical to believe that the condition could be cured by a ligation at this point. At times he did make other ligations at and below the knee.

Schede[25] was much more radical in his operative work and made circular incisions below the knee about the lower leg. These, however, never entirely encircled the limb and were made down through the superficial fascia, to the deep fascia of the lower leg covering the muscle. All veins encountered were cut and carefully ligated. His was a very radical procedure, however, and oftentimes the extensive incisions became infected. When they did so the condition immediately became a very serious one.

At times it is difficult to control this extensive infection and the injury to the lymphatic circulation is extreme. Due to this lymphatic destruction and injury the leg below this point remains swollen for a long period of time. After healing does take place the leg is very badly disfigured and the scars, left after healing, are extreme.

Von Wenzel used practically the same operation as Schede except that he included in his circular incision the lower thigh as well.

Pierre Delbet, the man who perhaps has done more work on the subject of varicose veins than any other surgeon, suggested the anastomosing of the saphenous into the femoral vein from 10 to 15 centimeters below the sapheno-femoral junction. This he suggested on the theory that the valves in the external iliac and the femoral vein were still normal and functioning and that it was a deficiency of the sapheno-femoral valve which permitted the reflux of the blood and the subsequent development of the varices. This, how-

ever, did not prove to be a success and has since been discarded.

Rindsleisch[25] and Friedel made spiral incision about the lower leg, similar to the Schede, after a preliminary ligation of the internal saphenous in the upper thigh. These incisions were carried down through the superficial fascia. Contrary to Schede and the other surgeons, they left their wounds packed wide open with gauze. The wound healed by granulation and left most unsightly scars. The author can see no possible justification for such a surgical procedure as this.

Madelund made long incisions over the internal and external saphenous veins, removing them and ligating the branches. The wound was closed by direct apposition at the same time.

Patzenstein believed that there was a lack of support and consequently in the need of more support to the vein wall to sustain the blood column, in accordance with most other authorities on the subject. He suggested giving the varices this needed support by transplanting them into the bed of muscles of the thigh and by suturing the muscles about the veins. This, however, did not prove to be a success.

Schwartz modified the Trendelenburg operation not only by ligating segments of the vein as Trendelenburg did, but also by removing segments of the vein both in the thigh and the lower leg.

Alglave has emphasized the theory that the most essential point in securing a good operative result is

the careful and complete ligation of all the perforating veins. This, of course, is very important in either the Trendelenburg *negative* or the Trendelenburg *double*.

The Mayo Method.—Charles Mayo,[16] in 1906, suggested a new method in caring for the varicose veins. He made an incision just below the sapheno femoral opening and carefully ligated the proximal end or stump of the vein. Then with a stripper, which he devised, consisting of a loop or eye on the end of a long handle, he threaded the distal segment of vein *through* this loop and pushed it downward or upward and stripped the main vein, usually the saphenous vein, from its branches, similar to stripping the limbs or branches from a tree trunk. He made no effort to ligate the branch veins whatsoever. Multiple incisions were made downward along the course of the vein to the ankle so that repeated segments of the vein might be stripped. This undoubtedly was a very marked improvement over the previous operative work. The skin incisions were very small in comparison and the possibility of infection was reduced almost to a minimum. The leg was then bandaged tightly to prevent hemorrhage from the torn ends of the communicating veins connected with the deep system. In many cases, however, this operation has been a failure due to the fact that the collateral veins continue to enlarge and dilate and oftentimes in a comparatively short time the patient's condition is as serious as it was at the time of the operation.

In 1907 Babcock[17] modified the Mayo operation slightly by passing a probe downward *inside* the vein. A new incision was then made over the lower end of the probe so as to bring it to the surface. After tying the ends of the vein about the contained probe, the probe was drawn downward. The vein was thus removed in practically the same manner as the Mayo operation except that the vein was inverted on itself while the Mayo method simply stripped or tore off the branches as the stripper was forced downward about the vein. No advantage can be seen in the Babcock operation in preference to that of Dr. Mayo.

Matas[25] has outlined the principles upon which the effectiveness of the operation depends as follows:

(*a*) To arrest the hemodynamic reflux of the column of venous blood in the superficial vein when the valves of these veins are incompetent and the varicosities accompany or depend upon progressive intravenous tension.

(*b*) To force the more superficial venous circulation from the less supported subcutaneous veins into the deeper more supported muscular trunks when these latter trunks are not involved in previous disease.

(*c*) To entirely and permanently remove incompetent or diseased venous trunks.

(*d*) To make impossible the entrance into incompetent superficial veins of blood from deeper intramuscular veins by obliterating enlarged parts of the communicating branches while in the act of excising the superficial trunks.

If ulcerations are present in the lower extremity as a complicating factor associated with the varicose vein, then we have an entirely different situation to face. All ulcerations are definitely infected and naturally any surgery directly about the ulceration is positively contraindicated until this infection is controlled. Most surgeons prefer to do nothing whatsoever in the way of surgical treatment of the varicose veins until after the ulcerations have been entirely healed. In their attempt to accomplish this result the patient is put to bed, oftentimes for several weeks. The leg is put in elevation with continuous hot packs or local applications of various types. Some authors apply the Unna's cast support from the very first. This course of procedure extends over a period of several weeks and oftentimes months. Due to his long period of bed rest and hospitalization the patient when he is discharged from the hospital is still not ready for work. It is very clear that there is a large amount of trauma associated with any of the extensive operations for varicose veins. This is true of some operations more than of others. Any trauma lowers the resistance of tissues to infection and decreases the possibility of their union by first intention. It is not at all uncommon to see these incisions become infected, with a low-grade type of infection, and slough wide open. Then we have the great gutters up and down the leg; they extend down through the fat and at times through the deep fascia; they continually drain pus and take several weeks to heal.

The Mayo and Babcock operations have been accepted today by many prominent surgeons as their choice of operative procedure for this condition; yet, it seems to the author that the surgeon is working in the dark. The tip of his stripper is entirely covered and he is blindly probing down through the fascia, stripping out the main varicosed vein and leaving untied all the collaterals. If it happens to be a very marked Trendelenburg negative in any particular case there is bound to be a large amount of reflux flow of blood from the deep system. It seems to the author that there is a great possibility of having hematomas formed in this manner along the channel of the stripper where they would be obscure and concealed by the covering of the skin along the route. This perhaps may not occur in the hands of a specialist or of an artist for this condition; however, the author has seen it develop and believes that it can be a very definite source of trouble and an ideal location for foci of infection to develop.

Mortality.—The operative treatment of varicose veins has always had a very high attendant mortality rate. This has been reported by many authors in the past and some authors, even with large series, show a mortality percentage of more than 1 per cent. Bernstein with a series of 378 operated cases gives a mortality rate of seven-tenths of 1 per cent. Anyone who has done any work with varicose veins has often seen the large hardened thrombi adherent to the walls of the varices which may have recovered

following attacks of a true infectious thrombophlebitis. Through the vein walls these can easily be felt like large kernels, though at times even as hazel nuts along the course of the scattered varices. Even though these may be adherent firmly by their base to the wall of the vein it has always seemed to the author that there was a great possibility of breaking them loose and thus of causing an embolus to develop. He believes that this is in all probability the source of emboli which do develop culminating fatally following the operative treatment for this condition.

Recurrence.—Herein lies the difference between the thrombi developing following repeated attacks of acute infectious thrombophlebitis, and those intentionally produced following the injection treatment of varicose veins by the use of sclerosing solutions. Again it is very apparent to the author, as has been recognized by all authorities and surgeons doing this work, that the percentage of recurrences following the operative treatment is bound to be extremely high. Naturally the percentage of recurrences would depend to a great extent upon the degree or the thoroughness with which the operative procedure was carried out. The more thorough and careful the resections of the great saphenous with all its branches, as well as those of the short saphenous with a careful ligation of all the communicating branches, the greater will be the possibility of a perfect and permanent result, and the less the possibility of a recurrence developing. Naturally the percentage of re-

currences markedly increases as time goes by. Only a comparatively few cases would recur at the end of a few months to one year while at the end of five years we see a large percentage of recurrences. Bernstein cites 85.7 percentage of subjective improvements in 147 patients under five years of observation, while only 73.2 per cent. of subjective improvements in 97 patients over five years of observation.

The recurrence of further attacks of infected thrombophlebitis and of ulcerations postoperative are also dependent upon the thoroughness of the operation. Edema of the extremity is almost a constant finding. In 244 patients examined he noted this 100 times very marked and definite. In my own experience it has been noted more or less in practically every case. In several cases it has persisted for many months. It is very discouraging to the patient and certainly gives a very bad cosmetic result. I believe that this edema is associated with and is a direct result of the extensive destruction of the lymphatic circulation in the superficial fascia which is associated with the radical operation.

Complications.—It has often been stated that the severe complication following the operative treatment of varicose veins was directly associated with the particular technic of that individual surgeon doing the operation. In order to gain information on this point the author[18] mailed a questionaire carrying nine questions to 1000 prominent surgeons in the United States, Canada and Cuba. These surgeons

were all members of the American College of Surgeons or men of equal standing in their community. The majority of them were chiefs of clinics or groups and doing a large volume of work. Many of the surgeons receiving the questionaire replied that they kept practically no follow-up records of their cases and so were unable to give me any particular information; however, 125 replies were received. Due to indefinite statements on some, only 119 groups of answers are included in my statistics (Fig. 16). The total number of cases reported was 6771. The number of cases operated by each doctor varied from 6 to 410 with an average of 54.16 per surgeon. There occurred 35 postoperative deaths from pulmonary embolus or 53 per cent. There was a total of 37 non-fatal pulmonary emboli, or 54 per cent. The most thorough reported questionaire gave two fatal 0.53 per cent. and 21 non-fatal or 5.5 per cent. in 378 operated cases.

There were 28 postoperative deaths due to other causes than pulmonary emboli with a mortality rate of 0.41 per cent. This gives a total postoperative mortality of 0.94 per cent. In reply to question No. 4, or the number of days in hospital postoperative, there were 111 replies with an average of 15.1 days. Ninety doctors answered the question as to the intervening time from the date of resuming work; this gave an average of 34.8 days. The last group of questions as to the number of recurrences was very poorly answered. Most of the doctors said that their

GRAPH OF THE QUESTIONAIRE.

		Percentage.	Replies.
1. Total number of varicose vein cases operated	6771	...	119
2. Number of deaths from embolus following operation	35	0.53	119
3. Number of deaths following operation due to other causes than post-operative embolus	28	0.41	119
4. Total number of post-operative deaths	63	0.94	119
5. Number of cases non-fatal emboli	37	0.54	119
6. Average number of days in hospital following operation	15.1	...	111
7. Average number of days, date of operation to date of resuming work	34.8	...	90
8. Percentage of recurrences 1 year	...	5	29
9. Percentage of recurrences 5 years	...	19.2	22

Fig. 16.

follow-up records were very incomplete and others that no attempt had been made to keep any record at all of these cases. Only 29 doctors reported as to recurrences in one year and 22 as to five year periods. After one year there was 5 per cent. and five years 19.2 per cent. of recurrences. These figures practically agree with those of Bernstein who has reported the largest series previous to this date.

In addition to the palliative and the operative treatment of varicose veins and their complications we have the more modern mode of treatment, namely, *the injection of sclerosing solutions* directly into the vein lumen. This will be taken up in detail in the next chapter.

CHAPTER X.

HISTORY OF INJECTION TREATMENT.

The history of the injection treatment of varicose veins dates from the invention and development of the hypodermic syringe by Pravaz at the Lyon school in 1851.

Soon thereafter, in 1853, Chassaignac suggested the obliteration of varicose veins by the injection of perchloride of iron and in 1855 Degranges used an iodotannic solution.

Vallett, of the Lyon school, in 1875, used the iodotannic solution again though it had previously been abandoned due to its excessive caustic action. He treated 200 cases with apparent good results and no severe complications. He insisted upon bed rest for his patients during a period of eight days following the treatment.

In 1884 English, of Vienna, discussed the pathology developing in the vein following the injection of the caustic fluid. He suggested that it was the injury to the intima with the subsequent thrombus formation which brought about a cure. He used a 5 per cent. alcohol solution.

While English worked in Vienna, Weinhemer again revived the treatment by the use of ferric chloride. Although he considered the treatment dangerous he reported 32 cases with good results.

In 1890 Trendelenburg surgically excised the great saphenous trunk as a cure for varicose veins, and in his work formulated the Trendelenburg sign which has stood the test of time in discussions of the circulation in the veins and varices of the lower extremities. This is mentioned here in view of the importance of this test in the injection treatment.

At the Surgical Congress of Lyon, in 1894, the injection treatment of varicose veins was much discussed and it was finally decided, due to the complications which all too frequently developed, to abandon the injection treatment.

Previous to the congress of Lyon the solutions used were caustic and coagulant in type, and naturally were doomed to failure. Soon the injection treatment, in spite of violent criticism, became the method of choice. Delorie took the leading part at that time and defended the iodotannic solution.

In 1904 Tavel[27] reviewed the subject before the Congress Medical Association Swisse and advised the use of 5 per cent. phenol solution which he injected into the varicosed segments of the vein. Due to the extreme coagulating effect this was also doomed to failure.

In 1908 Schiassi[28] reported before the Congress of Surgeons in Rome the result of his treatment during the previous two years. He used Lugol's solution combined with surgery. The saphenous magna was ligated just below the sapheno-femoral opening and then the lower segments injected with Lugol's solu-

tion. Schiassi wrote widely in 1907 and 1908 and in 1913 he gave the improvement in his technic. His method with modifications is still accepted by many as the ideal treatment for varices.

E. Unger modified Schiassi's technic somewhat but has given no definite refinement or improvement.

In 1911 Professor P. Linser[29] at the great Tubingen Skin Clinic noticed that the veins following repeated injections of corrosive sublimate in the treatment of syphilis would often become sclerosed and disappear. This finding he put to use in the treatment of varices of the lower extremities with much success. He used one cubic centimeter of a 1 per cent. solution of bichloride of mercury. His method was then accepted for several years and many still retain it as the ideal one for this purpose.

Coincident with Linser, Professor Sicard of the University of Paris noticed that when he treated patients with luargol, a solution with a large sodium radical, that he also got an obliteration of the vein. He reasoned that it was the sodium radical which gave results and suggested the use of a crystallized sodium carbonate solution.[39] This, however, proved too drastic and too caustic and had to be abandoned. With ideal results he later used sodium salicylate instead of the sodium carbonate. This he used in strengths of 20, 30 and 40 per cent. His method with these solutions has probably been accepted more widely throughout Europe and the world than has any other.

In 1923 Professor K. Linser,[30] working in Professor P. Linser's Clinic at Tubingen, began the use of sodium chloride. The results were so good that this was adopted by the Linser Clinic and since that time has been the solution of choice in that clinic. With the exception of sodium salicylate, sodium chloride with Linser's technic is used more extensively today than any other solution.

In 1917 Kausch[31] introduced the invert sugar solution called calorose. This is a solution of 73 to 76 per cent. invert sugar with 4 to 6 per cent. cane sugar. Professor G. Nobl later popularized this solution, and today it is used extensively. This at present, is the solution of choice for most cases in the author's work. In 1921 Genevrier[32] advocated the use of hydrobichloride of quinine and urethane, and reported many good results. Somewhat similar to Genevrier's solution is that advocated by Le Blaye and Vandier.[37] They recommended the use of a double hydrochlorate of quinine and urea in aqueous solution. This latter solution was first described by Bowdine before the Chemical Society of Paris in 1881.

Remenovsky[33] and others suggested the use of grape sugar. Moskowicz used it in a 50 per cent. solution called osmon and a 66 per cent. solution called varicosmon and thought that they were a definite improvement over calorose. Although the results were good, yet this solution was so expensive that its use has not been widely accepted.

In 1922 Montpelier and La Croix[34] advocated mercury biniodide. This solution gave positive results but at times the reactions were very severe; delayed reactions often developed in the saphenous higher up and today this solution is but little used.

In 1917 J. Troisier used sodium citrate in the treatment of arthritis and advocated its use in the treatment of varices, but it was never quite accepted.

Pregel's solution was much used for a time but, due to its coagulating effect on the blood, it has been entirely discontinued. There have been several deaths due to its use.

Ivanissivich[35] advocated the use of 30 per cent. phenolated glycerine. This, however, he used mostly in the treatment of hemorrhoids.

Recently a solution of invert sugar called invertose[36] as well as solutions of dextrose and glucose, has been used by many clinicians. These are prepared according to the theory of Professor Nobl and are used with his technic. The results are good. During the past three to five years no new solutions have been introduced, on the contrary, there has been a great refinement in the technic as well as in the individual solution used.

CHAPTER XI.

SOLUTIONS USED.

All the various solutions used in the injection treatment of varicose veins are best grouped according to the classification of C. Siebert and Wreszynski.[38] These authors group pharmacologically the cauterizing agents as follows:

Group 1. The salts which absorb water: Sodium chloride, calcium chloride, sodium salicylate and sodium citrate.

Group 2. The halogens: Tincture of iodine, Lugol's solution, Pregl's iodine solution.

Group 3. The alkalies, which have very strong cauterizing effects: Sodium carbonate solution.

Group 4. The heavy metals: Corrosive sublimate, iron perchloride, mercuric iodide.

Group 5. The organic cauterizing agents: Alcohol, dextrose, glucose, calorose (or invert sugar solution, Eli Lilly) and invertose (invert sugar solution, plain), quinine and urethane.

Of all the solutions mentioned classified under Group 1, the 20 per cent. sodium chloride solution is the only one which has stood the test of time and is still used to any great extent. This solution is perhaps the least harmful of all solutions used, though the technic of its administration is perhaps more exact than that of any other. If only a small amount

of the solution is deposited outside the vein an intensive paraphlebitis will develop and oftentimes a slough will result; however, with meticulous care this can be avoided. The concentrated sodium chloride solution, however, stimulates a very intense cramp through the lower leg which to many patients is almost unbearable without some type of anesthesia. The sclerosing reaction which develops in the vein is probably as firm and positive after sodium chloride, as that after any solution which is used. However, due to the intense cramp which supervenes, combined with the meticulous care which is demanded in its administration to avoid the sloughs and periphlebitis, this solution has also been discarded by a great many clinicians. It is, however, the safest of all to use as far as the systemic reactions is concerned.

None of the halogen solutions listed under Group 2 are used at the present time. They have all been discarded as too violent and severe in their reaction. Other solutions have been introduced which develop just as good results without the impending danger.

None of the alkalie solutions under Group 3 are used at present. Although Sicard[39] used the 10 per cent. solution of crystallized sodium carbonate, due to its intense reaction he discarded it in favor of the sodium salicylate.

Of Group 4, the heavy metals, bichloride of mercury is still used to some extent by a few men in individual cases. This solution must never be used with a total amount of more than one cubic centimeter of

a 1 per cent. solution. Larger amounts will give all the symptoms of mercury poisoning, salivation, acute nephritis, etc. This solution, however, causes no pain at the time of the injection and gives a very definite and positive result. It will cause a sclerosis and obliteration of the vein at times when no other solution will give this result. Though Montpelier and La Croix report good results from a mercury iodide solution, yet it has never been widely accepted and today it is used but little elsewhere than in their own clinic. The perchloride of iron has been used by many men during the period of development of this mode of treatment but today it has been entirely discarded.

Group 5 contains the most efficient sclerosing solution of all. Though some men have reported good results with alcohol injections, yet it is a blood coagulant and is quite painful to the patient on injection. It is particularly so if a paravascular injection is accidentally made. The sugar solutions have stood the test of time, though in concentrated solutions they all cause a painful cramp through the extremity. They stand next to the sodium chloride solution as regards non-toxicity to the general circulation or system. The grape sugar solutions have been discontinued almost entirely due to their expense, even though they were very efficient and effective.

The dextrose and glucose solutions are still used a great deal both in Europe and in this country. The invert sugar solution seems to have been accepted somewhat more widely in recent years in preference to the other solutions.

Genevrier's solution, the quinine and urethane, causes no cramp whatsoever at the time of the injection. It is not painful, it is effective in very small amounts, and yet it can be used in much larger amount than the bichloride of mercury without systemic results, and the author believes that it will entirely supplant the bichloride of mercury preparation in those cases where in the past there have been definite indications for the use of mercury. The silver salts, argrochrome, etc., have been discarded since far more efficient solutions have been produced. Sodium salicylate, similar to sodium chloride, and the concentrated sugar solution causes a cramp throughout the extremity at the time of the injection. In the more concentrated solutions this is very intense and severe. The results, however, following the injection of the sodium salicylate are very definite and positive, and the complete obliteration of the varicose veins is easily secured by its use. This solution is used more widely today than is any one single solution. The author has personally discarded its use due to the intense cramp which it induces.

Summary.—To summarize all the various solutions used at the author's clinic and in his experience, they stand in the following order in respect to their efficiency and preference for use.

1. Calorose (invert sugar solution, Eli Lilly) after the formula of Professor von Nobl: Invert sugar 75 per cent. and cane sugar 5 per cent.

2. Quinine and urethane, Genevrier's solution,

3. Invertose, plain solution of invert sugar in 50, 60 and 70 per cent. solutions.

4. Invertose compound: Solution of invert sugar plus sodium salicylate.

5. Sodium salicylate, 20, 30 and 40 per cent. solutions as used by Professor Sicard.

6. Sodium chloride, 20 per cent., according to the technic of Professor P. Linser.

7. Bichloride of mercury, 1 cubic centimeter of a 1 per cent. solution, suggested by Professor P. Linser.

CHAPTER XII.

INDICATIONS FOR INJECTION TREATMENT OF VARICOSE VEINS.

The indications for the injection treatment vary according to the conservatism of the clinician and according to his experience.

Professor Sicard is perhaps the most conservative of all; in fact, he considers only those cases as fitting and suitable for the injection treatment which present definite disabling pathology due to varicose veins.

Personally, the author believes the indication for the injection treatment of varicose veins should be very much broader than this, and he has come to believe that all cases of varicose veins should be treated by the injection method, unless there is some definite, positive contraindication, inasmuch as the danger entailed is so slight.

The conditions present and accepted as a positive indication for this treatment, by all men are:

1. Varices which are so large and painful that they partially or totally disable the patient.

2. Varices which have developed the complication of ulcer, eczema or pruritus.

In addition to the above the more liberal minded clinicians believe that varices associated with arthritic pains about the knee and ankle should be cared for. Oftentimes the apparent rheumatic condition is due to the varices themselves and not truly rheumatic.

The author does not believe that the complicating varices of pregnancy, when they are painful or distressing due to their large size, should be considered a contraindication. Personally he classes them definitely in the realm of cases demanding treatment. It is true that a large majority of these cases will partially or completely disappear during the few months following confinement; yet is it logical that we should ask a woman to suffer from three to five months with a condition which can be relieved with such little difficulty and with such comparatively slight risk? Is it reasonable that she must suffer and endure her pain and disability merely because she has the hope of being relieved of her fetus at the end of her nine months period and of gaining relief from pain soon thereafter? With this thought in mind he believes that every case of varicose veins accompanying pregnancy before the sixth month and which causes the patient any considerable amount of discomfort, either directly through pain or otherwise should have the injection treatment for her veins. The author chooses arbitrarily the sixth month, inasmuch as the amount of suffering entailed by this treatment can be compared to that the patient must endure through the last two months of her pregnancy—though not more.

The author treated one case of varicose veins in a pregnant woman where she was totally disabled at eight months, and yet three weeks later, one week before confinement, she was going about as happy

and contented as she was in the third month of her gestation.

The author sees no reason why vulvar varices should longer be classed in the contraindicated group. They are among the most painful varices we find and yet with a proper technic for the case they respond very well to treatment.

Varices present in cardiovascular and cardiorenal cases are on the border line. In each individual case the question must be decided whether the patient should or should not be treated. He believes that the treatment of large varices, in the mild case of decompensation can only serve to aid the general circulatory condition, and thereby improve the general status of the patient's health. For this reason he believes that many varices in the cases of mild decompensation are among those where injection treatment is indicated.

Last, but not least, he believes that all patients should have the right and privilege to decide for themselves whether or not they should have their veins treated solely for cosmetic reasons. It is just as great a calamity to the patient suffering from unsightly varices similar to the "spider" or "skyrocket" type, and as important to her that she receive treatment and a successful cure, as it is to the working woman who is positively crippled and disabled and thus kept from earning a livelihood.

The author has never been able to see the logic of forbidding this treatment to elderly patients. Some

of his most happy patients have been from seventy-five to seventy-eight years of age. Whether the particular and individual case at hand falls into the class of those where treatment is justified, must be decided in each case as it comes for care. Judgment must be used, however, in the choice of solution used in the treatment of the aged. Varices are often seen in the other extreme of life. The author had one patient ten years of age where undoubtedly the condition was congenital; yet, she felt much relieved following treatment. Thus age by itself is certainly no contra-indication.

Many clinicians extend the line of contraindications very broadly, yet with them the author does not agree.

The one contraindication accepted by all physicians is the case where a definite, positive, infectious, thrombophlebitis has been present at some time in the past, either following confinement or otherwise, and which has left the deep venous system of the leg severely injured or destroyed. In these cases the varices may be entirely compensatory in nature and therefore, must be preserved. On the other hand, the mere fact that the patient gives a history of a deep thrombophlebitis must not be taken as a positive contraindication to the injection treatment of her varices which may be present coincident with the former. If the patient responds correctly to the various tests which are used to prove the functioning of the deep venous circulation, and the circulation in

the varicose veins which may be present are of a reverse flow, the author sees no reason, whatsoever, why they should not be treated.

Recent cases of thrombophlebitis in the deep system will be a positive and definite contraindication and must remain so until time alone has proven the extent of destruction to the deep circulation and the infectious condition has entirely quieted down. Many authors feel that the stimulation produced following the injection treatment may reactivate the latent infection of thrombophlebitis, which at times persists for years.

Compensatory varices of the upper thigh and lower abdomen, which are thought to be indicative of obstruction to the iliac system, should be very carefully examined before treatment is given. They may also be due to the portal blockage of cirrhosis of the liver.

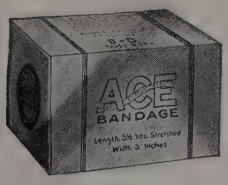
In cases of varices of the leg complicating large uterine fibroids or other pelvic tumors, the author believes the pathology of the pelvis should be cared for surgically first and the varices treated by injection later, if they persist.

Varices accompanied by elephantiasis may or may not be treated and each case must be decided by itself. The author believes that usually the varices in these cases are of such minor importance in comparison to the major condition, the elephantiasis, that they should be left alone and treatment directed toward the major condition itself.

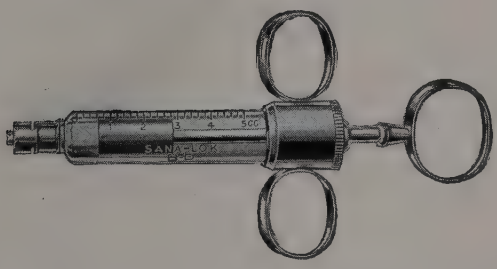
CHAPTER XIII.

ARMAMENTARIUM.

Syringe.—Inasmuch as the surgeon must at all times be absolutely positive that the needle point is



a, Ace bandage. 4 inch preferred.



b, Sana-lok control syringe. Glass barrel and stainless steel plunger.

c, Erusto needle. Stainless steel. Short bevel. (Becton, Dickinson & Co.)

Fig. 17.

resting within the lumen of the vein and not in the perivascular tissues he should have a syringe by means of which he could alternately inject and aspirate without disturbing his hold on the syringe barrel,

or the position of the needle within the vein. This is important for the success of this particular treatment. It is best accomplished by means of a syringe having two rings on the barrel of the syringe for the fingers and one on the plunger for the thumb (Fig. 17). This gives the surgeon absolute control of the syringe, with the needle attached, so that he can continue his negative pressure on the syringe barrel immediately as soon as the needle point has penetrated the skin and until it is well within the lumen of the skin. By means of this negative pressure as soon as the needle point penetrates the vein wall the blood will be quickly aspirated back into the barrel of the syringe. With the other hand the needle and barrel of the syringe can be stabilized so that with the fingers and thumb of the first hand in the rings before mentioned, alternate positive or negative pressure may be administered on the fluid within the barrel of the syringe so as to either inject the fluid or to aspirate the blood from the vein. By this means the surgeon can at all times tell exactly where his fluid is going and whether or not the needle point is correctly placed.

Needle.—The type of needle is very important (Figs. 18 and 18*a*). Use the smallest needle possible with which the particular solution used can be injected. The writer prefers a short bevel needle about three-quarters to one inch in length. The accompanying plates very clearly demonstrate and show the value of a short bevel needle correctly placed and with the bevel placed at the right angle. If the veins were

distended when we inserted our needle, as is the case when we give intravenous medication, then it would matter neither what particular type of needle point we use nor the caliber of the needle.

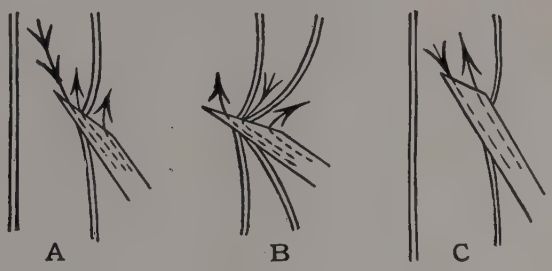


Fig. 18.

Wrong and right insertion of needle into the vein. (Becton, Dickinson & Co.)

A, Long bevel may aspirate blood and yet allow a perivascular injection.

B, With the vein nearly empty a long bevel will compress so as to penetrate posterior wall and give a perivascular injection.

C, With vein moderately distended a short bevel with sharp point assures a perfect injection.

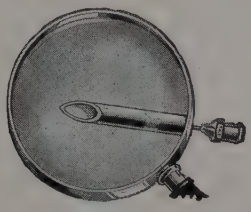


Fig. 18*a*.

Proper point of needle under magnifying glass. Note the short bevel. Sharpen it daily. (Becton, Dickinson & Co.)

In the treatment of varicose veins, however, we are working just the opposite to the situation which exists when giving intravenous medication. In the

latter case we have the tourniquet applied about the arm for the purpose of causing the vein to become distended with the venous blood flowing back from the extremity. As soon as we are sure that the needle point is well within the lumen of the vein the tourniquet is removed, the positive pressure against the blood flow is reduced and the fluid is injected against the negative pressure, rather with a very definite negative or aspiratory pressure drawing the fluid onward toward the heart. This suction is sufficient to practically collapse the vein as soon as the tourniquet is removed and with the arm lying in the horizontal. Just the opposite condition, however, is present in the injection treatment of varicose veins. In this case it is our sole purpose to keep the large dilated varices as collapsed and empty of blood as possible.

As was discussed in the chapter on the theory of the injection treatment, our purpose is to bring the injected fluid in as concentrated a solution as possible into intimate contact with the lining of the vessel, the endothelium. The more concentrated the solution, the more complete is the destruction of the intima of the vein wall at and about the site of the injection. Thus the more empty the varix is at the time of the injection the more concentrated will this solution remain.

If the varices are already filled and distended with blood as the fluid is injected, the solution will be reduced in concentration to far below the point of ef-

ficiency and we will have nothing more than a slight irritation to the wall of the vein, the intima. In this case the solution would cause only a very slightly irritant action, perhaps not even sufficient to cause a fibrin deposit and a condition which nature would repair in a comparatively short period of time. If the sclerosing solution is injected under these conditions and in this manner it is certainly very clear why we should not expect to get an obliteration of the varicosed segment injected. It is clear then that the more collapsed and empty the varix is when the injection of the fluid is started the more perfect will be the result of our injection.

Thus it is very clear how much more careful and accurate your technic must be in order to enter a collapsed and almost empty varicosed vein, and yet not to penetrate or puncture the posterior wall than it is to enter when the vein is distended and tense, such as the bicipital vein, when giving an intravenous medication.

The plates (Fig. 18) show and very clearly demonstrate how a needle with a dull point may actually collapse the two walls of the vein, press them together in such a manner that both layers or rather both walls of the vein will be penetrated at one time and the needle point come to rest behind the posterior wall or entirely outside the vein. In this way we have gone clear through the vein and if we make the injection in this position the fluid injected will be deposited entirely perivascular. Again if an attempt

is made to aspirate with the needle point in this position no blood can be aspirated, proving to the surgeon that his needle point is not within the vein lumen.

This condition of the collapsing of the vein wall, pressing the two walls together so that the needle will puncture both walls at the same time either occurs with a dull needle point or in case the varicose vein had been irritated and sclerosed. This happens at times after it is present for many years, or as is the case after previous injections where the fluid was strong enough to give an irritant action to the vein wall, and yet not concentrated enough to develop the destructive action which must follow. If the needle point is of a long bevel and the vein wall thin, as often happens either in the smaller varices or in the larger types of varices where the walls are stretched very thinly, then as the plate very clearly shows the needle point can be sufficiently within the vein lumen to aspirate blood back into the syringe under a strong negative pressure; yet, when an attempt is made to inject the fluid, most of it will be deposited outside the vein wall. This could occur on either the anterior wall or the posterior wall of the vein.

This condition would not occur with a very short bevel needle. Figure C, in the plate, shows the correct position in which to hold the needle point at the time of insertion into the varicosed vein in order to be the most sure that you do not puncture the posterior wall at the same time. It is more difficult to

insert in this position, than with the bevel tipped in the opposite direction. Most companies furnish the 22 gauge needle or larger in either the long or the short bevel, and they will make to order the needles with smaller caliber with a short bevel.

The author firmly believes it well worth the time and expense to have the short beveled needle prepared.

Bandage.—For a tourniquet the author prefers to use the three-eighth inch rubber tube about twenty-four inches in length. Shorter than this is too short for the large thighs, yet the tourniquets if longer are in the way for the small part of the lower leg. A rubber tube one-eighth to one-quarter inch in diameter is so small that the patient complains of it cutting the leg and a larger tube is bunglesome.

At times for the purpose of compressing and collapsing the large varices as will be discussed later on, the author prefers to bandage the leg immediately following the injection. This is also used in the pressure treatment of varicose ulcers. For this purpose he prefers to use a very strong, cotton, loosely woven bandage. The loosely woven bandage will stretch and give and thus will give a great deal the same effect as the elastic bandage, yet lasts much longer. For this purpose a good grade of bandage must be used as the cheaper ones are insufficient. In the author's experience he has found no bandage as yet that compares with the *Ace cotton elastic bandage* for this purpose, though there are many others on the market and some much less expensive.

Sponges.—The rubber bath sponges used must be of a very good grade. The cheaper grades soon lose their resiliency and their pressure, while the better grades may be used many times. These are supplied in three different sizes and it is much more efficient to have the right size for the particular case at hand than it is to try and cut down the larger size to fit the ulcer. Once more let the importance be emphasized of getting the best grade rubber sponge possible. These are just the plain rubber bath sponges.

Table.—The author prefers to have his patients sitting on the end of the ordinary examining table. He can then have the patient stand or recline at will. Some men prefer to have their patients stand with one knee on a chair and steady themselves by holding to the back of the chair. This, however, would depend on the technic of each individual surgeon and on the type of solution used. Professor Sicard of Paris has devised a very ingenious table for this work at the Necker Hospital.[40] This table is a combination of a table and a chair. By this means he can very easily have his patients either sit upright or recline. However, the ordinary examining table serves the purpose very well.

CHAPTER XIV.

TECHNIC OF THE INJECTION.

Preparation and Position of Patient.—At the time of the appointment the patient is asked to strip both legs as high as needed to expose all veins to be treated. The patient is asked to stand on the stool at the foot of an ordinary examining table and the legs are thoroughly cleansed with alcohol, 75 per cent. preferably. When standing the varicose veins will distend the same as happens and occurs during daily work. Then with an applicator, with 5 per cent. mercurochrome, the sites for the injections into the varicosed segments are selected and marked out. Tincture of iodine may be used as well.

It is far better and less confusing if the operator marks only those segments into which he plans to make his injection, instead of marking out the entire course of the varicose veins. All the varices of both legs are marked out at the one sitting. The patient then lies prone on the table and in the case of the very extensive varices, where both Trendelenburg positive and negative or a Trendelenburg double is present, the foot of the table may be elevated. On the contrary if the reverse flow is not marked the legs are allowed to hang downward over the end of the table, and an assistant, sitting on a stool, will elevate or lower the leg as needed for the effects of

gravity to either empty or fill the varices of the extremity. The exact position of the extremity at the time and during the injection will vary with each and every individual technician and with each case separately. It must be left with each operator to use his own judgment as to how to keep the vein or varix most empty and collapsed and thus to offset the Trendelenburg reflux pressure in the vein.

Injection of Fluid.—As stated before, the purpose of the injection and the treatment is to bring the concentrated injected fluid into intimate contact with the endothelium of the vein and it must be left to the judgment of the operator how this can best be done. Personally, in all cases or practically all cases, the author starts his injection in the lowermost segment of the dilated varices and then he proceeds upward, one group of segments at a time, until the entire limb has been treated.

A tourniquet is placed about the extremity at the level of the lowermost varix and with just sufficient tension to obstruct the circulation in the superficial vein, but not tight enough to cause a constricting effect on the veins of the deep system. The leg is then elevated so that the effects of gravity will aspirate the blood from these varices and leave the collapsed vein, which can be easily seen as bluish venous lines and channels under the skin. A second tourniquet is placed about the extremity with practically the same pressure as the first and about four to six inches above. The idea of the tourniquets is

to localize the injected fluid to this particular segment or to any particular segment of the varicose vein as long as the operator wishes. This can be best accomplished by having a distance of about five to six inches between the tourniquet rather than ten to twelve inches as some operators prefer. The veins in the section between the tourniquets are now collapsed and empty; yet, by having the assistant use pressure with the open hand to milk or force the blood from all the varices into one loop or segment that loop can be sufficiently distended that the operator can with ease introduce the needle point into the vein lumen and yet do so without fear of perforating the posterior wall.

With this particular technic it is clear how the fluid injected will be in a practically concentrated form and thus we can expect to get a most perfect and ideal result from our treatment. Just in the degree that this solution is concentrated or to the extent that it is undiluted by the blood remaining in the varices will we have a perfect result. The actual amount of fluid injected into each varix or group of varices must be judged at the particular time and according to the case in hand. This can be gained only by experience. Usually just enough fluid is injected to make the vein distended and under moderate tension. Again far less fluid will be needed if it is concentrated than if it is markedly diluted. Again if the injection is made directly into the main channel of the varix it will spread through all its collaterals just

as well, oftentimes, as though it were injected into each separate varix. However, at times the author has obtained better results with multiple injections of small amounts into the scattered loops or varices between the tourniquets than by injecting into only one loop a larger amount and depending on its spreading throughout the scattered varices and collateral veins.

After the injection of the fluid is made into the vein lumen the operator holds still with his syringe and needle *in situ* for approximately three to five minutes to allow the fluid to cause its destructive, corrosive action on the intima of the vein. The needle is not withdrawn for two reasons: First, if it was withdrawn with the vein distended the injected and corrosive fluid would ooze backward out through the hole in the vein wall, caused by the needle, thus causing a periphlebitis or perhaps even a slough, and second, the pressure by means of a sponge over the site of the puncture to prevent this leakage would immediately force the injected fluid out of this segment and thus limit its destructive action. Thus by leaving the needle in place with the vein distended, the corrosive action sought is accomplished; yet, leakage is avoided during this five minute period of waiting and later absolutely controlled by immediate application of sponge pressure, which is further controlled by the application of strips of adhesive.

After all those varices between the tourniquets have been treated by single or multiple injections a new tourniquet is applied four to six inches above the

uppermost of the two just used. Previous to the application of this third tourniquet, the leg is again elevated so as to empty and collapse the group of varices still remaining above the tourniquets and the segments which have just been treated. The third tourniquet is applied with the same pressure as before and the varices in this segment are treated just as those previously described and with exactly the same technic. The tourniquets are left remaining on the extremity restraining the fluid in the segments just treated for about five to ten minutes longer, and at times until the varices in the segment above have been partly or completely treated. The first tourniquet is then removed permitting the escape of the sclerosing fluid into further varices of the superficial system, or into the communicating branches and the deep system at will.

After all the varices of the second group of the extremity have been treated, the leg is again elevated and another tourniquet, or the one which was used about the ankle to begin with, is now placed four to six inches above the last tourniquet applied. The veins in this segment are emptied and collapsed as before, and then injected with the sclerosing fluid. In this way the varices in one segment of the leg are treated successively, one group after another, beginning at the lower group and going up the leg and thigh until the uppermost segment has been injected. It is very important to avoid leakage of any solution that may be used in this sclerosing work; however,

it is much more important and particular to avoid the leakage in the case of 20 per cent. sodium chloride, the sodium salicylate, quinine, bichloride of mercury and metaphen. Calorose (invert sugar solution, Eli Lilly) will cause a marked irritation, but the small amounts of only a few drops, as a rule, will not cause a sufficient irritation to give a slough.

Number of Injections.—In the author's opinion there is no particular limitation to the number of injections used in each sitting. This particular point must be decided with each individual case. Naturally if there has been an old nephritis or a history of a diabetic or cardiac condition, or the patient is highly nervous and minds the pain and cramp extremely, then it is best to use only a few injections at a time. Other patients would prefer to have the whole thing through with at the one sitting and to know that their case was practically completed. The author can see no other possible contraindications to the use of more injections or to a larger total amount of fluid than these. Of course there remains, and always will remain, the theoretical possibility of injury to the intima of the deep system by permitting such a large amount of this fluid to pass from the superficial system to the deep system in the course of such a short time.

In the author's opinion this is more theoretical than real; however, he believes that it can happen. It is due to the possibility of this occurring that he has insisted that the application of tourniquets be just

sufficiently tight to control the flow of blood in the dilated superficial varices and not tight enough to act with any constricting effect whatsoever in any way on the veins and vessels of the deep system of the leg. It is very conceivable how the fluid could be retained in the deep system after it had entered them from the superficial veins thus to continue the sclerosing

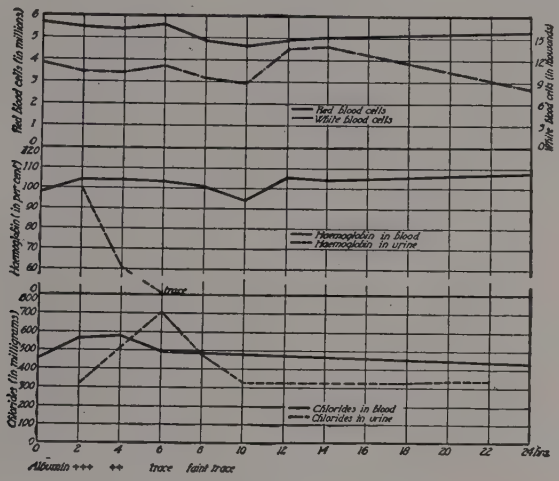


Fig. 19.

Composite graph showing the results on the blood and urine following 20 per cent. sodium chloride injection. The urine hemoglobin is due to the breaking up of the red blood cells (hemoglobinuria and not hematuria).

effects there; however, this in the author's opinion, is clearly a breach of technic and with good judgment should not occur. Here again, as to the amount of constrictive pressure which must be applied, the operator must use his own best judgment. More pressure must be applied in some cases than in others.

The author does not believe that there is any systemic reaction developing following the injection of calorose, or of salt solution and that these solutions may be used in any amount desired (Fig. 19). The amount of sodium salicylate solution, however, must be very carefully controlled. Professor Sicard, who perhaps has used more of the sodium salicylate than any other one man, urgently advised that never more than 3 grams of the salicylate be used at one sitting. The patients will develop a reaction to salicylate much more quickly than other solutions and in some it is much more prolonged. Sicard recommended small doses of the salicylate to begin with, and then to increase to the larger doses of the more concentrated solution as needed and as the tolerance of the patient has become established. Patients have an idiosyncrasy to salicylates practically the same as to quinine. And the reaction, shock and collapse which develop subsequent to their injection is practically the same as that following the large amounts of the quinine solution.

The dosages of quinine and urethane preparation, again, must be limited to the particular individual.[41] Some patients will develop a mild reaction after an administration of not more than one-half cubic centimeter, while other patients can stand four cubic centimeters with no difficulty whatsoever. The men who have used the most of the solution agree with the author that the best results are obtained when injections are made of one-half to one cubic centimeter

in scattered varicosed loops and yet when not more than a total of four cubic centimeters are injected at each sitting until the tolerance of the patient has become established, then larger amounts may be used.

The author believes that throughout this whole injection treatment the flow of the injected fluid should be under the control of the operator at all times. By means of the tourniquets and by allowing the needle to remain *in situ* sufficiently long to have the corrosive action of the sclerosing fluid to develop he can limit and control the destructive effect to those segments of the veins treated. If this assumption be true then it is best and wisest to free and clear the extremity of the injected and sclerosing fluid as soon as sufficient corrosive effect has been obtained.

With this idea in mind it is the author's belief that those extremities with large varices, size three and four and larger, should be elevated high to again empty the varices of the sclerosing fluid and to be sure that all this fluid has been emptied from the deep system. In other words if he is through with this fluid, then get rid of it. With the large varices emptied and collapsed the leg is then bandaged with a strong Ace bandage so as to prevent the refilling of the varices as soon as the patient gets on his feet. With the leg thus bandaged the patient is immediately allowed to get up and dress and go about his work.

The author believes that the increase of the circulation in the lower extremity obtained during walking will thoroughly and completely wash the veins of

the deep system of all the fluid that may have remained up to this time after the treatment. If the large varices are not emptied of the sclerosing fluid as suggested, but the patient allowed to sit around and not walk so as to increase the circulation, then the corrosive effect of the fluid may continue to the extent of a complete destruction of the vein wall in this segment, giving a gangrene or necrosis which will later break down and have to be opened and drained. This, however, is a breach of technic and should not occur, and furthermore, will not occur if the above technic as suggested is followed.

It will be recalled that it is the purpose of all this treatment to develop a thrombus within the vein completely filling its lumen, secondary to an irritation and partial destruction of the endothelial cells of the vein. It is by means of this complete obliteration of the vein lumen with a firm thrombus that we obtain our results.

To the author it is very logical, if his assumption be correct, that the large varix, size three and four and larger, should become filled with a firm, hard thrombus, the same as will those of size one. If this be true, is it not logical to compress and collapse the large varices so that when they do fill with a thrombus it may be of a size one instead of a size four or larger?

It must be remembered that the large thrombi in order to secure obliteration of the vein must go

through the same process of organization as the smaller ones. It is certainly logical that it would take the large thrombi much longer to go through these successive stages than it would the small ones. Again the possibility of recanulization and redevelopment of the varices would be much greater with a large varix where the center of the thrombus would certainly become softened and with much more difficulty become organized than would be the case in the small thrombus. It is with this particular thought in mind that the author insists and urges the bandaging of the extremities with the large varices immediately following the injection and to keep them bandaged successfully for four to six days as needed.

Though the above is the technic used by the author yet good results are obtained by other men with less detailed work.

The bichloride is best used by the injection of ½ to 1 cubic centimeter of a 1 per cent. solution into the distended varix with the patient standing and with the finger of the operator compressing the walls of the vein at the point of the injection so that the solution is brought directly against the vein wall. This will give a thrombus about 2 inches long. The injections are repeated every three days until the case is completed.

Others use the quinine and urethane and the sodium salicylate in the same manner. Some inject the latter solutions with the patient standing and

the vein distended and then leave the needle *in situ* two minutes before withdrawal and the application of the sponge and adhesive.

In all cases and with any technic the operator must be sure that there is no leakage from the needle tract.

CHAPTER XV.

POST-INJECTION TREATMENT.

It is certainly logical to expect a certain amount of pain and soreness following a treatment of this sort, and the author always tells his patients that their legs are going to be sore and that for a few days they will notice difficulty in getting about. This, however, is not severe enough in the average case to keep the patient at home and from work.

In an extensive case following the large amounts of chemical periphlebitis which has developed as a result of the treatment there is naturally a certain amount of swelling in the extremities. Due to this fact patients are much more comfortable if the bandages are changed at the end of twelve to twenty hours and then reapplied very snugly yet not so tight as at the first application. They should then be re-bandaged every twenty-four to forty-eight hours, for four to six days, depending on the size of the varices in the individual case. The patient is much more comfortable with the support than without. Analgesic tablets are given for the pain and soreness following injection if the patient notices it severely.

Usually any of the mild sedative tablets are sufficient. External heat, as a hot water bottle or electric pad, oftentimes gives much relief, and particularly so in the case with large varices in the thigh. It is

difficult to bandage the varices of the thigh in order to give continuous support on account of the "peg leg" type formation of the thigh; for as soon as the patient begins walking, the bandage works loose and slips downward and the support has been entirely lost. When there are large varices of the thigh the author prefers to support them with wide strips of adhesive about four inches wide and long enough to go about half way about the thigh; the first strip is placed about two inches below the lowermost edge of the large varix and overlapping other strips above as needed until the whole area is covered and supported. This gives much comfort to the patient and does not need to be removed for four to six days postoperative.

This same adhesive strapping will give great comfort and support to the case with varices in thigh, even though the varices were not particularly large which develop a reaction or periphlebitis. If the varices in the thigh are particularly large or cavernous, the author prefers to make a pad of sheet wadding carefully folded so as to collapse them before the adhesive strips are applied. This gives the same effect as the bandaging in the lower extremities and certainly adds to the patient's comfort. Following this technic the author does not hesitate to inject the varices of the thigh even to the groin and many times has he injected the varices just outside the saphemoral opening with the most perfect result, and most thoroughly advocates this method of treatment.

In all the severe and extensive cases the author prefers to see his patients on the next day post-operative. This is simply in order that he may re-bandage the legs a little more loosely for the patient's comfort or care for any particular condition that may have arisen. After the first day he sees his patient every two days.

As a rule, unless the patient comes from a distance and should be very anxious to return home, no further injections are made for about one week to ten days. Under those conditions other varices may be injected even on the second, third and fourth day. However, oftentimes we will find the veins finally disappearing after several days, which on the second day looked as though they would need further injection.

If we start our secondary injections on the second or third day some injections may be given needlessly. However, in this point is the crux of the whole situation, for thoroughness means success and no patient is discharged from treatment until the case is completely cleared up. The case is continued under active treatment for ten days to two weeks at which time if everything is apparently all right the patient is told to return again in two or three months as may be convenient for them.

On this visit it is the usual thing to find a few scattered varices not completely sclerosed and though at the first sitting calorose or sodium chloride was used for the injections, at this time the author pre-

fers to use the quinine and urethane preparation. This causes no cramp, is not painful at the time of injection, can be given with a very small 26 gauge needle and is not particularly annoying to the patient at all. After the varices are cared for at this visit, the patient is again told to return in five to six months for further inspection and again one year from the date of beginning treatment.

In this way the possibility of some of the treated varices becoming redeveloped or recanalized is avoided as they are located and treated on some of these visits. The new varices that may have formed during this time are also treated so that at the end of one year the patient can be discharged and pronounced practically cured. As has been discussed before the mere fact that the patient is discharged at the end of one year with all veins sclerosed does not guarantee to an individual patient that he is not going to have more varices form as time goes by. If the etiological factor is still present, as has been discussed in a previous chapter, then that particular patient is most certainly going to develop more varices from year to year, and this point must be very carefully explained to the patient; otherwise he will feel that your work is incomplete and inefficient, and will not be satisfied. With this point thoroughly explained the patients are very anxious and happy to return from year to year to be sure that their varices are cared for, and they realize that it is far

more simple to care for a few scattered veins in the early stages than to allow them to go until they arrive at the state as extreme as they were to begin with.

CHAPTER XVI.

RESULTS OF INJECTION OF VARICES WITH SCLEROSING SOLUTIONS.

The pathology that develops in the varicose veins following the injection of the sclerosing solutions is practically the same even though many different types of solutions may be used. These results will be discussed under the heading of the immediate, secondary, and late.

Under the immediate results the painful cramp in the extremity should be considered first. This pain is exactly similar to the cramp in the muscles of the leg when swimming, etc., and at times as though being continually stimulated by the electric current the muscles of the leg can be seen to quiver and jerk. This occurs much more severely and intense when the injections are made into the varices of the lower leg and particularly into those of the calf. It is also very painful when the injections are made about the ankle.

Some authors have tried to explain the painful cramp as due to the stimulations of vessels or muscles of the vein wall. This, however, I do not believe, for usually the varices remain distended as would not be the case if their muscle walls were constricting so strongly as to cause pain. Other authors have explained it entirely on a sympathetic basis. Neither

is this acceptable to the author. The pain is not nearly so severe when the injections are made into the veins high in the thigh. This is best explained by the fact that the fluid in this case does not so directly stimulate the muscles of the calf or of the thigh as is the case when the injections are made lower down.

The cramp is most severe after the 20 per cent. sodium chloride, the sodium salicylate solutions, and the calorose when used very concentrated. When small amounts of the salicylates are used the cramp is very moderate as is also the case with a weaker calorose or sugar solution. At times immediately following or during injection the whole group of varicose veins will collapse and disappear, and where there were large veins formerly, now the operator will be able to palpate a groove which proves clearly that the vein is completely, though only temporarily, collapsed. This contraction is never attended with the painful cramp. It is due, however, to the intense stimulation and resultant contraction of the muscles of the vein wall. It would seem to the author then, that this phenomenon is a positive contradiction of that theory as a cause of the pain.

At times, due to the psychic effect of the needle puncture and the stimulation of the pain or cramp, combined with her imagination, a highly neurotic patient may even show symptoms of collapse. If any of the solution is injected perivascular the patient will notice a sensation of burning, and at times a pain,

though different from the cramp-like pain which they have experienced previously throughout the leg. If the patient complains of this sensation the injection is immediately stopped and a pressure sponge is placed over the needle puncture to prevent future leakage.

Secondary Results.—When the patient returns on the second day or first day postoperative the treated varices are seen to be hard, tender, red and inflamed. This at times extends throughout the whole course of the varices and then again seems to be more or less localized to the certain segments and loops involved, as though the sclerosing fluid had not spread widely through the varicosed segments. These loops are tender to pressure. At times as though the fluid had spread, by a process of osmosis, through the vein wall to the perivascular tissues there will even be a periphlebitis. This condition, however, is very definitely and distinctly limited and reaches the crest of its severity on the second day, progressively receding thereafter.

It is in this one particular point that there is such a contrast to the acute infectious thrombophlebitis which develops at times in the varicose vein. The latter is not limited as to time, duration or severity. As has been discussed in a previous chapter they spread from loop to loop, from segment to segment, or even limb to limb. The chemical thrombophlebitis, on the other hand, is very definitely localized to the section of the vein which was brought into contact

with the concentrated solution injected. The corrosive effect of the solution is definitely limited as soon as the solution passes from this part to the general circulation, and the thrombus does not extend farther than the loops on which the corrosive action of the solution was directed. The perivenous chemical thrombophlebitis varies in degree with the tension of the solution in the loop injected, with the thinness of the vein wall and with the concentration or sclerosing effect of the solution injected. This is much more with some solutions than with others.

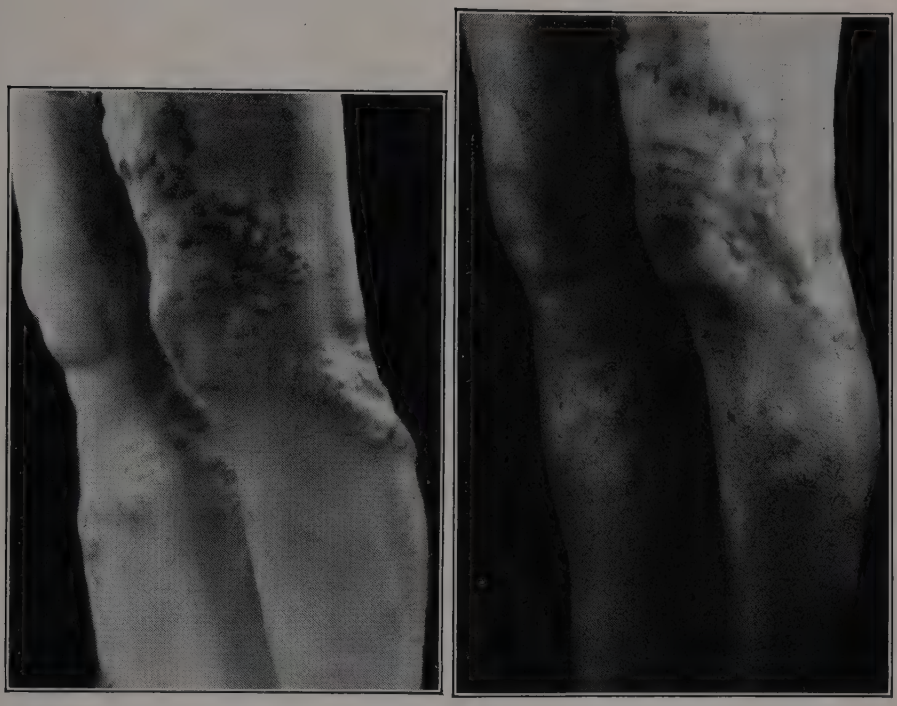
At times this chemical thrombosis does extend up the saphenous magna to the sapheno-femoral opening even though the injections were only made about the lower third of the thigh. To the author it is very clearly explained by the fact that at times there are no communicating branches between the superficial and the deep system above the lower third of the thigh. If the injection had been made into this segment of the vein, then it is very easy to see how, with the lower end of the vein collapsed and destroyed by previous injection and yet with this segment filled with the corrosive solution that the corrosive effect would have continued throughout the whole extent to the sapheno-femoral opening—even though the solution was much diluted by contained blood and of a weak concentration—yet resting there over a long period of time.

This condition is most often seen after the use of the mercury biniodide, according to the opinions and

technic of Montpelier and La Croix. This particular solution, however, is very seldom used any more and most clinicians have discarded it though the authors themselves still claim ideal results and advocate its usage. If with the sodium salicylate, the sodium chloride or the quinine solutions a certain amount of the material may have been injected perivascular due to errors in technic, the patient will first complain of the burning pain, before mentioned, and within a few minutes thereafter, usually three to five, at the site of this injection, there will appear a spot of grey ecchymosis "or blanched spot" which, in many respects, simulates an early gangrene.

This, of course, is seen only if the solution injected perivascular is very superficial and near the skin. If the solution incorrectly injected may have been posterior to the vein and in the deeper tissues, the "blanched ecchymotic" spot will not be seen, yet on the contrary the burning and smarting will continue several minutes to half an hour thereafter, and the area will become progressively more and more sore for the next several days. If this blanched ecchymotic spot is seen and an immediate infiltration of the area made with sterile normal saline, infiltrating it widely and deeply, nothing particular will occur other than the soreness of the tissues on the succeeding days which will quite rapidly subside.

However, if not a sufficient amount of saline has been injected to dilute the injected sclerosing solution below the concentration that the tissues are able



Before treatment. After treatment.

Fig. 20.

Mrs. H. A. Varicose veins.

to withstand without necrosis, then we will have a development of a slough or area of wet gangrene. If it is near the skin and yet not extensive, there will be a black dry gangrenous scab formed of the skin layer itself.

If it has been decided that there has been a perivascular injection made, and the type of solution used which will cause a definite slough or necrosis, things may be done to care for the condition at hand. Some operators have advised immediate and complete excision to be made of the whole area, under local anesthesia, as soon as the condition is diagnosed. Others would advise to wait and return on the second to fourth day and then make a complete excision of the area at that time, or do so only when they thought there was a definite necrosis developing. They would then close the area the same as any resection or minor operation. This is done with the best of asepsis and we should have healing by first intention and the case should progress normally otherwise.

If such an area or slough develops and a resection is not done, then healing will take place through the slow and tedious process of separation of the dead and gangrenous tissue of the slough and of the healing of the base by granulation. Though it takes many weeks or months for the most severe and deep sloughs to heal with this treatment, in all cases it will occur. The process of healing is very slow, and the granulations seem lifeless. There is nothing to do, however, other than to give continued care and the application

Before treatment.

After treatment.

Fig. 21.

Mrs. M. T. Before and after treatment with 20 per cent. sodium chloride.

of silver nitrate to the area of the slough with the thought of stimulating the granulating tissue to greater activity, to dress the sloughs from day to day as needed. At times the water cooled ultra violet light seems to stimulate granulation and healing of the slough. Naturally this long process of healing will leave a pigmented scar with which the patient is very displeased (Figs. 20, 21 and 22).

Late Results.—Under the heading of late results the author wishes to consider the process of organization which has proceeded subsequent to and as a result of the injection. This is given in detail in the following chapter. That portion of the chapter on the micropathology has been contributed by Dr. Nathaniel Lufkin, pathologist at the Minneapolis General Hospital and associate in the department of pathology at the University of Minnesota.

Fig. 22.

Mrs. M. C. Before and after treatment with 20 per cent. sodium chloride.

CHAPTER XVII.

PATHOLOGY, GROSS AND MICROSCOPICAL, FOLLOWING THE INJECTION TREATMENT.

HISTOLOGY OF THE NORMAL VEIN.

Veins are composed essentially of three easily distinguished layers. The inner layer, or intima, is composed of a single layer of flat connective tissue cells called the endothelium. Beneath this is a very thin layer of delicate fibrous tissue strands which in turn are bounded by an elastic membrane. This internal elastic membrane is never so prominent as that found in arteries.

Occasionally small longitudinal muscle bundles are found in the intima and in the intimal portion of the media, in the saphenous and certain other veins. The middle portion, or tunica media, is the thickest layer and consists largely of smooth muscle fibers, most of which are circularly arranged. Between the muscle fibers are varying proportions of connective tissue cells, and through them run elastic fibers in varying numbers. The media is best developed in the veins of the lower extremities. In the upper extremities this layer is thinner, and in the veins of the abdominal cavity it is quite scant. The outer layer, or adventitia, consists of interlacing bundles of dense connective tissue fibers among which is a network of fine elastic

fibers. Occasionally this coat contains small bundles of longitudinal muscle fibers.

Nerve fibers and minute blood-vessels occur in this coat and distribute their terminal branches to the two outer coats of the vessel. It is apparent that there is considerable variation in the normal histology of veins. This variation in structure is probably due to variations in function and in location with reference to surrounding structures. In addition, different portions of a single vein, such as the saphenous, may show great variations in the proportions of its constituent structures. These facts must be borne in mind when endeavoring to form a picture of pathological changes.

HISTOLOGY OF VARICOSE VEINS.

It seems fairly well established that in the early stages of varicosities there is a general hypertrophy of all the contractile elements. As dilatation continues there is a gradual progressive atrophy of these same elements so that in the fully developed varix both elastic tissue and muscle tissue show evidences of extreme atrophy. The wall of the vessel is thinner and frequently has become entirely fibrous. At the same time there may or may not be changes in the intima in the form of proliferation which produces nodular elevations not dissimilar to those seen in arteriosclerosis. Calcification, and even ossification may occur in varicose veins of long duration. Inflammation has been described in varicose veins, but

because of its infrequent occurrence is generally regarded as due to secondary infection in an already diseased vessel and not an essential part of the process of the formation of a varicosity. In the study of injected specimens, therefore, it will be seen that one must not only bear in mind the variations in the structure of normal veins but the even greater variations in the structure of varicose veins.

HISTOLOGY OF VARICOSE VEINS AFTER INJECTION.

A few European investigators have studied veins of animals and of humans after injection of sclerosing fluids.

Bazelis noted the following changes after the injection of mercury biniodide: After twenty-four hours the endothelium was swollen and partly separated from the remainder of the intima. There was no clot or thrombus and no leucocytic infiltration. After forty-eight hours the endothelium was unrecognizable and the internal surface of the vessel was covered by a deposit of fibrin. After seventy-two hours there was a clot entirely obliterating the lumen. In eight days the clot had been penetrated by newly formed connective tissue, rich in capillaries. After fifteen days the process of organization was not yet complete but the muscle layer was described as almost completely sclerosed. After three months the vessel was greatly diminished in size and transformed into a fibrous cord, only a few isolated muscle fibers being recognizable.

Régard examined the vessels of dogs and rabbits at the end of one to eleven days after the injection of bichloride of mercury. He described first a swelling of the endothelium with detachment from the wall after the first day. After three days fibrin covered the internal surface of the vessel and a clot obliterated the lumen. A day or two later the process of organization had begun with the penetration of fibroblasts into the clot.

Von Meisen found after injection of sodium salicylate into the vein of a horse that a red thrombus formed immediately. Within twenty-four hours this was moulded and stuck to the wall, and in six days organization had begun. He also studied the saphenous vein of a man who died of coronary sclerosis two and a half months after the last of a course of four injections of 20 per cent. sodium salicylate. The vessel was filled by a thrombus which was everywhere adherent to the wall through the growth of new vascular tissue from the internal layer.

Sicard and Gaugier reported findings essentially similar to those mentioned above. Sicard speaks of the primary change caused by the sclerosing fluid as a chemical inflammation or an endovenitis and pervenitis which he says is to be sharply differentiated from infectious phlebitis.

Jentzer and Askanaz injected collargol with the sclerosing fluid and found that within a few hours this material had spread through all coats of the vessel.

None of these observers have described exudative inflammation in veins after the injection treatment.

For the present study 33 segments of varicose saphenous veins, size 3 to 4, were removed from treated patients, from one hour to one hundred and nine days after injection with calorose or sodium chloride solutions. These segments were all taken from the great saphenous vein at a point four to six inches above the knee, on the medial aspect of thigh. They were fixed in 10 per cent. formalin solution, imbedded in paraffin, sectioned, and stained with hematoxylin eosin. Weigert's stain was used to demonstrate elastic tissue, and the Van Gieson stain was used for fibrous tissue. Due to improper fixation, undue distortion in removing or sectioning, and other accidents, a number of specimens proved to be unsatisfactory for study. The present report, therefore, is an analysis of the processes found to be taking place in 22 separate specimens. Only a brief summary is to be given here. A more comprehensive analysis will appear in the current literature.

In one hour no particular changes could be noted. The intima was somewhat thickened due to subendothelial proliferation, but this was regarded as an old process, and probably a part of the original picture of the varicosity. At two hours the vessel was filled by a recent and rapidly formed thrombus. There was a layer of fibrin adhering to the endothelium and red blood cells were entangled in this material.

At five days there was organization beginning with penetration of the clot by fibroblasts and young capillaries (Fig. 23).

The seven, twelve and twenty-one day specimens showed increasing progress of organization, which in the last specimen was nearly complete but still lack-

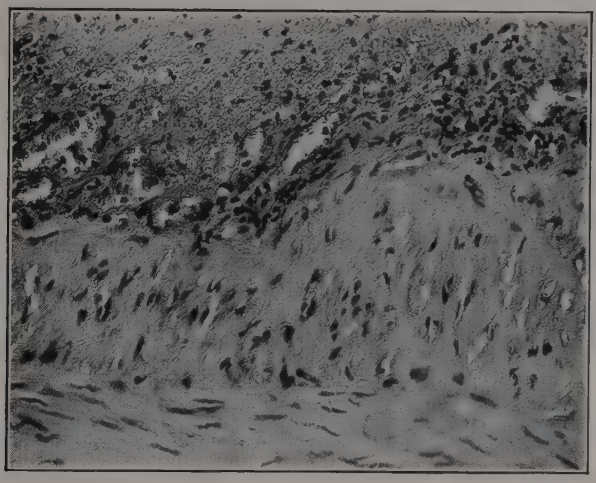


Fig. 23.

High power photomicrograph of a varicose vein seven days after the injection treatment. Three different layers may be distinguished. The lower layer is the muscularis media; the middle shows the intima, thickened by old proliferations; and the upper layer shows a recent thrombus. Nearest the intima it contains a number of capillaries, and here and there may be seen the elongated nuclei of fibroblasts.

ing in a fairly large area at one side, where the appearance of normal clot was still obtained. At thirty days organization was somewhat less advanced than that seen in the twenty-one day specimen but hemolysis of the red cells had begun. At forty-seven days

organization had extended through practically the whole clot.

Only a small area near the center showed the absence of the young capillaries and fibroblasts. At sixty-three days and at ninety days organization was absolute complete (Figs. 24 and 25). The fibrous tis-

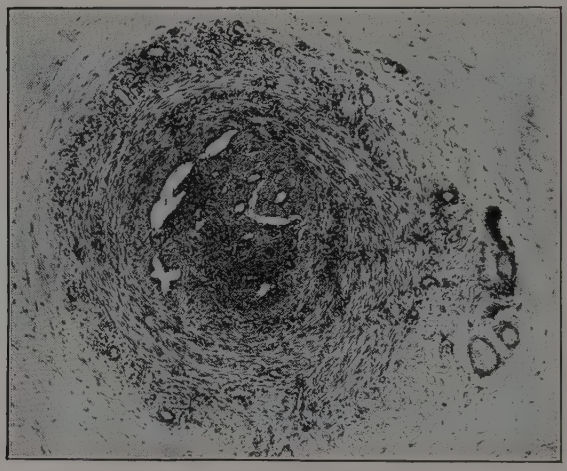


Fig. 24.

A low power photomicrograph of a varicose vein sixty-three days after injection treatment. The lumen has become entirely obliterated by fibrous tissue. The small clefts seen are capillary spaces and represent an attempt at recanalization.

sue which obliterated the lumen showed the presence of a number of capillary spaces and a quantity of brownish blood pigment, the remains of the old thrombus. The vessels were tremendously shrunken, being only about 2 millimeters in diameter at the point where the sections were taken. The specimens taken at fifty-six, eighty-six and one hundred and nine days

showed well advanced but still incomplete organization. This apparent discrepancy will be considered shortly.

Among findings noted incidental to the study of the process of organization were an old thickened intima in twelve of the twenty-two specimens. This

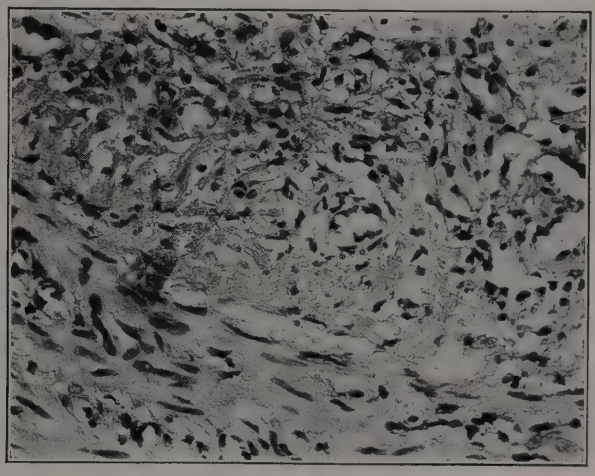


Fig. 25.

A high power photomicrograph from a small portion of the vessel seen in Fig. 24. The muscularis media is seen at the lower left portion of the field while the remainder represents young fibrous tissue and capillaries. Under the microscope, a small amount of brown blood pigment can be seen.

thickening was essentially similar to that described in the first hour specimen. These lesions showed no evidence of active proliferation and were therefore to be regarded as a degenerative process present before the injection. The endothelium, shortly after injection, showed none of the evidences of injury that were de-

scribed by European observers. This may be accounted for by the fact that the earlier writers used stronger irritants than were used in this series.

All specimens studied showed degenerative changes in the muscular coat. These changes varied from vacuolization and hydropic degeneration of the muscle fibers to hyalinization in large patches. Many showed extreme atrophy of the muscle bundles with an increase of fibrous tissue between them. Still others showed a high degree of vascularization, and in a few muscle tissue was practically absent in large portions of the circumference. In none of the sections could the elastic tissue be regarded as normal. The internal elastic membrane in nearly every case was either fragmented, or split, or both. Only a few specimens contained any elastic tissue in the media. In the adventitia, elastic fibers were usually quite numerous, but in a few they were entirely lacking. These changes likewise are probably to be regarded as having been present before injection.

Twelve of the twenty-two veins showed some degree of exudative inflammation in the adventitia. This in most cases consisted of small foci of lymphocytic infiltration about the vasa vasorum. The exact significance of these focal infiltrations is somewhat uncertain. Numerous observers such as Epstein, Collagnburgher, Nobl and Lohr have described similar findings in varicose veins that have not been injected, but on the other hand Lehmann, Bernstein and others found no cellular infiltration. It has al-

ready been noted that the findings of exudative inflammation were lacking in the injected specimens studied by von Meisen, Sicard, Bazelis, Wolf and Linser. It is probable, therefore, that the presence of lymphocytes should be regarded as due to mild infection of an already diseased vessel, and not as secondary to the injection treatment.

Only one of the sections showed a diffuse exudative inflammation. The process involved all of the coats and the cells were largely of the polymorphonuclear and mononuclear types. This particular vein was removed from the immediate vicinity of an infected ulcer and the inflammatory changes noted, therefore, cannot be ascribed to the injection treatment.

All of the vessels from the five-day stage on showed organization to some degree. The general tendency was for this process to become more advanced as time elapsed after the injection, but the degree of organization was not necessarily co-ordinate with the time elapsed after injection. The possible reasons for this are to be sought first, in the state of the vessel wall. It would be reasonable to suppose that a vessel wall poor in living tissues might give rise to proliferative phenomena more slowly than one in which the walls were more normal. This possibility could not be denied, but a study of the sections at hand showed that frequently organization was as far advanced from a very atrophic segment of the vessel wall as it was from a more nearly normal portion.

The general nourishment of the vessel and the tissue surrounding it, and the state of the vasa vasorum could very possibly be controlling influences in the development of organization. These factors from their very nature would be difficult to determine accurately, and each might have an influence. In the lack of accurate knowledge on this point they must be considered as purely hypothetical.

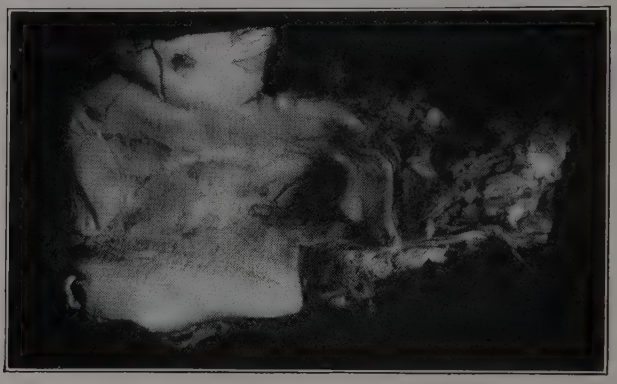


Fig. 26.

Autopsy specimens from case treated with sodium chloride, 20 per cent. and dying of a coincident coronary sclerosis, 21 days later.

Section removed at autopsy at junction of the long saphenous with the femoral vein; intact normal valve in femoral vein with eroded sclerosed saphenous.

The third possibility is that organization may take place more rapidly in one segment of the injected portion of the vein than in another. That this is a probable explanation is apparently proven from the study of the sixty-three day and the ninety day specimens. Numerous sections were cut from each specimen of

these veins that was presented. Four separate blocks of each showed great atrophy and well advanced organization; but in no portion was this process complete. In one or two sections the lumen, though greatly reduced in size, was still patent. Other blocks, taken from more constricted portions of the vessel, were found to be completely obliterated. Not only was the lumen closed by fibrous tissue but the

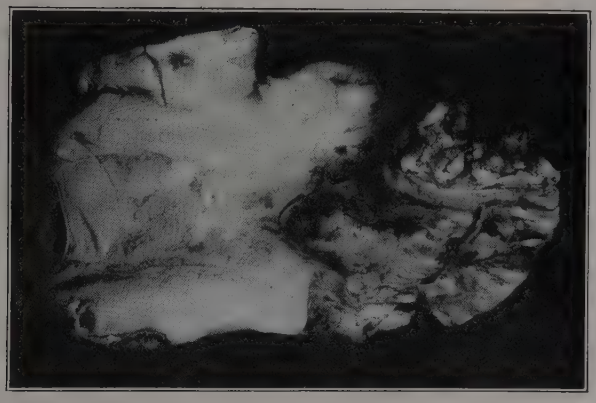


Fig. 27.

Definite line of demarcation at the junction of the saphenous with the femoral vein, limitation of corrosive action of the injected fluid. Note the corroded valves of the saphenous vein on comparison with normal valve of femoral.

media showed great increase in these elements and there was a marked atrophy of the muscle. These last two segments of veins were the longest of any that were presented, and it was therefore possible to take multiple blocks. In the earlier experiments, to minimize the trauma, only small segments were removed and from these it was practical to take no more

than one or two blocks. The two long segments were definitely beaded in character, with slight dilatations that were still partly filled with blood clots and nar-

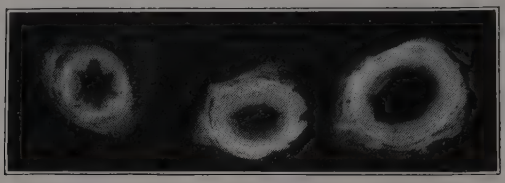


Fig. 28.

Transverse section of saphenous vein one inch below saphenofemoral junction; sclerosis and contraction of vein wall; thrombus dislodged during preparation.

Fig. 29.

Section through veins at level of knee. All veins filled with hard, firm thrombi which in section show organization.

rower segments that had become greatly fibrosed or greatly atrophied.

Although the experiments have not yet been completed it seems justifiable at this time to assume that

Fig. 30.

Cadaver specimen of varicose vein injected with calorose five days before death from coincident cardiac exit. Vein was firmly thrombosed. Specimen shows the marked tortuosity and multiple convulsions due to the elongation of the vein during the process of the varicose development. Note the tip of the induced thrombus at upper end. Note the normal appearance of the endothelium of the femoral vein opened at upper end of figure.

organization takes place with varying degrees of rapidity at various points in the lumen of the injected vessel. Some of the points become completely fibrosed, perhaps between the fiftieth and sixtieth day, while at other points the process takes place more slowly and occurs only at a later period, or perhaps not at all. In any event the circulation is completely stopped and the vein undergoes, as far as we have observed, if not a complete fibrosis at least in segments, at any rate a very high degree of disuse atrophy. The end result is the same, namely, obliteration of the varicose vein as an entity (Figs. 26, 27, 28, 29 and 30).

CHAPTER XVIII.

COMPLICATIONS DIRECTLY FOLLOWING THE INJECTION TREATMENT.

The subject of complications following the injection treatment is best considered under the head of direct and indirect. Under direct complications the author will first discuss the one theoretically the most common, the one most serious and practically the only one terminating fatally even though it is the most rare of all. It is that of pulmonary embolus.

Pulmonary Embolus.—A pulmonary embolus develops from a preformed thrombus. The thrombus is intentionally produced as a result of the injection of the sclerosing fluid. An embolus forms and develops by a small or large segment of this thrombus breaking loose within the vein and floating along the vein lumen toward the heart. Theoretically an embolus should develop and form in every case and following every injection. Thus if we made twenty injections into separate segments we have that many potential sources of emboli. This is the case when a condition of the acute infectious thrombophlebitis is present, yet it is not the condition following the use of sclerosing injections. The pathology developing in the vein, with its subsequent organization was discussed under the heading of "late results following the injection treatment." It is clearly shown how the

thrombus is definitely limited and localized and how it is definitely organized and attached to the vein wall, which thus precludes the possibility of an embolus developing.

It is only when some other intercurrent condition develops such as a complicating acute infectious thrombophlebitis associated with the injection treatment that the author believes there is a possibility of having an embolus after this treatment. Due to the fact of the direction of the venous flow in varicose veins, as was clearly demonstrated by the lipiodol injection, emboli from segments of the thrombus breaking loose and spreading into the general circulation are very rare.

The direction of the venous flow in these cases is not toward the femoral vein and the heart, as one would expect, but on the contrary the blood flows distally from the sapheno-femoral opening downward through the veins of the lower leg, through the communicating veins into the veins of the deep system and by this route of travel joins with the blood in the general circulation.

If this is true, and we know it is, then the theory that the emboli are aspirated toward the heart directly upward from the thrombosed section of the saphenous vein, thus causing emboli, is wrong. On the contrary, agreeing with Sicard and many other authors on this subject, these thrombi and portions of emboli are forced distalward and are thus arrested by the branching of the vein and by the fact that the

varices and veins below are smaller and theoretically the more the patient is on his feet, increasing the pressure downward in the great saphenous, the more firmly it will wedge the thrombus into the varices below and thus make embolus formation next to impossible.

If the segment of thrombus broken loose is large, then it will block the opening of the pulmonary artery and cause instant death, while if it be smaller, it may pass this point occluding the lumen of one of the smaller terminal arteries in the lung. Again if it is very small it may pass outward in the arteries of the lung blocking only a small terminal segment which may be of little particular consequence.

It will depend on the amount of lung tissue involved and blocked off by that portion of the arterial tree involved that we will have our serious symptoms develop. If only a real small portion is blocked off then the symptoms will be those of an acute pulmonary irritation, coughing, pain in the chest, dyspnea, and perhaps spitting of blood. The latter, however, will not occur if only a real small segment of the lung is involved, and the symptoms will vary directly from the immediate fatal pulmonary embolus occluding the whole pulmonary artery at base of heart to the very minor ones just mentioned.

If the area involved is very small it will heal and the patient recover by the development of a pulmonary infarct and the patient will make a perfect and permanent recovery. After a very thorough review of the

literature[42] only four cases were found definitely diagnosed pulmonary embolus which proved fatal, though in this same report a total of approximately 53,000 cases from the great clinics of Europe as well as the United States were collected and reviewed.

Emboli are more prone to follow and develop following the use of coagulating solutions. This was discussed in detail under the chapter on solutions and these particular solutions are seldom used at present. Those used by the author have no coagulating effect on blood, whatsoever, and produce their results by the direct effect on the vessel wall.

Sclerosing Phlebitis.—The development of or extension of the "venitis" of Sicard or the sclerosing phlebitis should not be considered as a complication; however, some authors do consider it as such. It seems to the author that this condition should be considered simply as a continuation of the sclerosing process, intentionally produced and should not be looked upon as a complication and it should not be feared. In fact the author does not feel satisfied if this process does not extend upward and thus obliterate the saphenous vein to the sapheno-femoral opening.

At times this condition in the saphenous of the thigh becomes very tender and painful. To assure the permanency of his result he believes that the saphenous vein should be and must be completely obliterated upward to the sapheno-femoral opening. If the theory of Delbet and Mocquot is correct that the condition of varicose veins is due to a dilation of the

valves in the femoral and in the saphenous system, then it is certainly of prime importance that the great saphenous vein be tied or obliterated, the same as with surgical excision, immediately at this point. If this is not done, it is certainly logical that we may expect a complete recurrence of the condition in a comparatively short time through the development of collateral veins from this point outward over the thigh and circulating around a former area of sclerosis.

The author believes that the man who does not do his work thoroughly is defeating his own efforts and will have many more cases of recurrence of varicose veins than the clinician who is thorough in his work. Considering all the factors associated with the venous flow as demonstrated by the lipiodol injection, and considering the facts according to Delbet and Mocquot, and bearing in mind the pathology which we know develops following the injection of the sclerosing fluid, the subsequent organization of the thrombus, he does not believe that there is any greater possibility of an embolus developing from a thrombus extending up through the great saphenous to the sapheno-femoral opening with complete obliteration of the vein at this point, than when it is used in the lower leg. The "venitis" of Sicard is tender and painful.

However, if this phlebitis is treated with a supportive treatment, combined with the application of heat as much as possible, as we advise, it will not cause the patient any great amount of difficulty. On

the other hand, if in the opinion of the operator associated with the injections there has developed a coincident, infectious, thrombophlebitis then he most certainly would keep the patient at rest and treat the patient as one of an acute infectious thrombophlebitis.

If this condition develops then we have all the possibilities for a pulmonary embolus developing the same as in a primary case of acute infectious thrombophlebitis, and the treatment should be just the same and just as thorough. The author believes that the development of this condition subsequent to and associated with the injection treatment is comparatively rare and with proper technic and proper care it will not occur. In the report on complications was given the case histories of several cases gleaned from the literature on the extension of the thrombosis following the injection.

As seen in those case reports and the discussion associated with each, the authors felt that there had occurred an acute thrombophlebitis from some distant foci of infection or error of technic which had been superimposed on the intentionally produced thrombosis, secondary to the injection.

The thrombosis was partly due to the infectious thrombophlebitis and it was the latter which continued to extend up the vein or even to the other leg, the same as occurs in any infectious thrombophlebitis. The author does not believe that this extension will occur if no infection has developed except in the case similar to the closed end of the femoral, with no com-

municating veins, thus allowing the prolonged action of the sclerosing fluid even though it is diluted.

Sloughs.—The development and occurrence of sloughs following the injection is most definitely and positively a complication; however, the author believes this condition is due solely to an error in technic and should not occur. In his practice it has not occurred for many months. This was discussed in detail in a former chapter.

The occurrence of a fatal septicemia following the injection treatment can occur as has been previously discussed. With proper technic and care this should not occur. It must be remembered that the large thrombi in the vessels make an ideal site for growth for any infection which may be introduced. For this reason thinking of the possibility of infection the technic associated with this work in every way must be cautiously guarded. The operative work, such as a resection of a slough, following the injection, must be done with all the care and asepsis of a surgical operation, and if this care and technic is followed there need be no more fear of infection than in any surgical case.

CHAPTER XIX.

COMPLICATIONS COINCIDENT OR ASSOCIATED WITH THE INJECTION TREATMENT.

The complications coincident and associated with the injection treatment of varicose veins are important only in a negative way. They often cause much criticism for the doctor. On first thought those conditions which arise coincident and associated with the injections are often considered as direct complications of and following the injection treatment. When a complete and thorough investigation is made, however, including physical and laboratory examinations and an autopsy if possible, they are proven to have no relation whatsoever, and are merely coincident therewith.

In the author's experience this has occurred on three occasions:

Case I. A patient died of a coronary thrombosis twenty-one days after the injection of his veins, yet a most careful history taken during the last day of illness revealed nothing in his past history which would suggest the presence of the cardiac condition previous to the last week. Severe criticism was made of the treatment and the death was attributed to it in some way. Autopsy examination, however, showed the pathology present and proved the mere coincident relation of the two conditions. To those who criticise

the treatment in the presence of a developing coronary thrombosis, the author merely cites the opinion of prominent internists that this condition often develops to a fatal issue with no premonitory symptoms sufficient to attract attention.

Case II. A patient developed diabetes four months after treatment. Later he developed a gangrene of toes and foot. Quite naturally superficial examination made the diagnosis of gangrene following the injection treatment. This, however, is physiologically impossible and a simple urine examination revealed a well developed case of diabetes with onset dating after the treatment, but in no way related therewith.

Case III. This patient, a woman, was one of thromboangiitis obliterans. Careful and complete examination including X-rays made a differential diagnosis. The pathology here is primarily in the arteries. The circulatory disturbance had its onset associated with the presence of a moderate case of varicose veins and with severe symptoms developing a few months after the treatment. Even though there is no relation some critics hold the injection treatment as the causative factor in the development of this coincident and associated condition.

CHAPTER XX.

THE TREATMENT OF ULCER CRURIS.

Results of treatment of ulcer cruris have always been unsatisfactory. Ointments and lotions are legion and include those used by the Indian healers, the miracle men, the professional quacks, and those employed today by the profession. The author does not believe the direct application of any particular solution or ointment, in itself, has any particular value looking toward the recovery of this condition (Figs. 31, 32, 33 and 34).

As was discussed under the chapter, Etiology of Varicose Ulcers, he believes that it is primarily the pathological circulation present which is the cause of this condition. If that be correct, as has been proven many times, then the most essential point in the treatment of varicose ulcer is to correct or attempt to correct the circulatory condition present. When the circulatory condition is corrected or supported and brought as near the normal as possible the condition very rapidly improves and clears up practically by itself.

The application of silver nitrate in 10 per cent, 20 per cent. or 50 per cent. strengths, here the same as in other surgical conditions is definitely stimulative to the granulating surface. The author uses some mildly stimulating ointments more for the purpose of

Before treatment.

After treatment.

Fig. 31.

Fig. 32.

Ulcer of 27 years duration before treatment.

Fig. 32.

After treatment.

Fig. 33.

Before treatment.

Fig. 33.

After treatment.

preventing the dressings from sticking to the granulating surface when the wound is dressed than for their healing effects on the wound itself. Any mild ointment, preferably of a zinc oxide base, with some mild, stimulating, healing, medicament incorporated is sufficient for this purpose.

With the two-fold thought in mind of giving support to the dependent extremity and of correcting the pathological circulation present—in addition to the application locally of a soothing, healing preparation—the Unna's cast has always been accepted as the most efficient treatment previous to the past few years.[51] Many men today advise the cast applied directly over the large, open, weeping, badly infected ulcer area, and changed as needed every two or three days.

Certain authors, of whom Pondorff[43] is one of the most prominent, believe in the vaccine treatment and in the development of an autogenous vaccine from the bacteria present in the ulcer and that he thus inoculates himself against his own infection. Pondorff believes that the secretion from the ulcer area retained by the Unna's cast which acts as a boot softens the indurated skin. A secondary reabsorption occurs through this softened skin surface and the patient becomes inoculated with his own autogenous vaccine. Few men, however, agree with this theory at the present day, and the author has little faith in it.

The use of Boynton's[44] adhesive strapping with the adhesive strips applied directly over the ulcer area

A

Before treatment.

B

After treatment.

Fig. 34.

S. R. *A*, Varicose ulcers before treatment. *B*, Ulcers healed following injection treatment of veins and secondary skin graft.

for support has many advocates and oftentimes has given good results. The best results are obtained when the original technic is followed; the limb is strapped with strips of adhesive, one after the other; beginning at the toes and working upward with each succeeding strip of adhesive slightly overlapping the last, the foot, ankle, and lower leg are strapped well above the ulcerating area. These strips of adhesive are put on snugly. The whole limb is thus encased in a support of adhesive greatly similar to the application of the Unna paste which has been discussed.

It is plainly seen that the basic principle of both these methods is practically the same. This adhesive strapping is left on and lets the wound become bathed with its pus secretion until it finally oozes through between the straps of adhesive and saturates the dressing. The adhesive is then removed, the wound cleansed and restrapped. The adhesive strapping of Boynton as well as the application of the Unna paste has been the best hope of the surgeon in the treatment of this annoying condition until recent years.

In the past the surgeons have felt that operation was necessary and have devised all sorts of procedures having as their goal the correction of the defective circulation. Primarily the varicose veins were operated as was discussed in the chapter on The Surgical Treatment of varicose veins. In addition to the resection of the offending vein, usually the saphenous magnus in the case of varicose ulcers, further surgery must be done. Many surgeons have

realized the association of the varicose vein directly with the ulcer area itself.[45] Some men have made multiple incisions about the ulcer at a distance of one inch or so down through superficial fascia and thus cut and ligated all the varices present feeding into the ulcer. Areas of good tissues are left, however, between the incisions to supply nourishment to the area. Other men have attempted to excise the ulcer area and thus destroy all the varices present in the ulcer bed and then let all wounds heal by granulation. Some men have attempted to cover the whole area at the time of the resection by means of a pedicle flap skin graft. It has been suggested by some that lateral incisions be made from the ulcer and that these incisions be carried down through the deep fascia and then under the ulcer itself and thus lift the ulcer tissue from the deep fascia in one large flap. In this way they hoped to obliterate and destroy all the veins that might be feeding the ulcer from below, or its base.

Theoretically this was right and would have been successful were it not for other factors present. In many cases these surgical measures have been a rank failure. They might have been successful in the cases where there were varices present only about the ulcer and where the ulcer was not large. Again the ulcer itself and the tissues thereabout should not be operated upon until the infection present is definitely under control.

The author believes that operation is definitely contraindicated in these large badly infected and

necrosing ulcerations. The patient must be put to bed with the foot at high elevation and with the application of solutions, lotions, and packs of various kinds.

In order that the infection might be definitely controlled and that the possibility of an infectious thrombophlebitis developing at the time or following the operation be entirely precluded, some authors have insisted that the patient be in bed at least three weeks under this treatment.

Following all these operative measures patients must remain in bed from two to three weeks postoperative for care and treatment. Even then after this three to six weeks of intensive hospitalization and treatment the patient has no better chance, if as good, for permanent healing of the condition present, than after the more modern or the injection treatment combined with the appropriate supportive measures.

The author believes that at the outset of the treatment of any case of varicose ulcer two conditions must be recognized. First, that the primary condition or etiological factor present is the reverse flow of blood in the saphenous vein. As was discussed in the chapter on etiology this causes the stagnation of blood in the parts, which lowers the resistance of the tissues to infection. Second, that following the reverse flow of blood with the consequent congestion of the tissues there occurs some slight trauma as the immediate cause of the ulcer development. If this assumption is correct, then our measures must be an

attempt not only to correct or stop the reflux flow of blood through the saphenous vein downward from the sapheno-femoral opening, but our efforts must also be toward supportive measures which may aid the venous and lymphatic circulation of the tissues in particular of the lower leg, directly about the ulceration. If this condition is not recognized and cared for it is difficult or impossible to get a complete and permanent recovery of the ulcer. On the contrary if these two factors are thoroughly realized and corrected every ulcer *due to varicose veins* may be healed and kept healed.

Temporarily both of these etiological factors can very well be corrected by means of the supportive elastic bandage combined with rubber sponge[8] pressure and this is the technic followed in the author's clinic. By means of the elastic bandage and sponge pressure the reverse flow of blood in the venous system into the ulcer area can be overcome and thus the excessive accumulations of fluid in the tissues about the ulcer, which causes a lowered resistance locally, can be stopped.

The author prefers to let the injection treatment of the varicose veins wait in these cases for a period of a few days until the condition present in the ulcer itself and the tissues thereabout are improved by means of this supportive bandage. The time or period of injection of the veins in these conditions is strictly optional and can be done at any time and delaying the injection of the vein until some later

period during the course of treatment does not delay the recovery of the ulcer itself and does not prolong the full course of treatment. The supportive bandage takes care of the reverse flow just as thoroughly as though the large dilated varices have been excised in operation or have been injected previous to our initial treatment of the ulcer itself. These large infected, necrosing ulcers are always painful and the thing that the patient is primarily interested in is relief from his pain and his distressing situation. This relief to the patient should be the primary factor in our course of treatment.

So long as the ultimate recovery from his condition is not prolonged it matters not to the patient when his veins are injected or cared for if he gains immediate relief from his pain. With this thought in mind the author first treats all his ulcerations with the bandage and sponge pressure until the infectious condition of the ulcer is well in hand and the ulcer is showing marked improvement and the nutrition of the tissues locally has markedly improved. It is this compression treatment which relieves the patient from the period of hospitalization entailed with the old treatment and which permits him to be cared for by the modern ambulatory method. When the latter treatment is used and the proper support is given to the extremity with the correct application of the sponge and bandage the patient makes a far more rapid recovery. When he is ambulant the muscular contractions on walking massage the leg and force

the excess fluid from the tissues, thus rejuvenating and giving them proper nutrition. With this aid the circulation rapidly approaches normal.

The actual treatment of the ulcer itself in the author's Clinic is that of the method of Rodolpho Klapp in the Clinic of Berlin, with the additional use of the large rubber sponge and supportive bandage as advised by Professor Nobl. In addition to these he has made many suggestions which to him seem to be an improvement.

A SUMMARY OF THE ULCER TREATMENT.

When the ulcer case presents himself for treatment a careful examination is made the same as in all other cases. His history is gone into, as to the etiology of the condition present. Complicating factors of diabetes, nephritis, etc., are considered and each ulcer case is discussed and considered by itself. Unless some complicating factor presents out of the ordinary, the ulcer and the skin about is carefully cleansed with benzine. This solution is better to cut discharges left on the skin surface than any other and is not particularly painful to the patient. If the granulations are large, coarse, and of the hydropic type the treatment is facilitated by the application of stick silver nitrate.

This, however, is painful to the patient and is not necessary in view of the pressure treatment to follow. The ulcer and the skin surface about is covered with the ointment. This is best put on gauze and then

the gauze and ointment applied to the ulcer. A good grade rubber bath sponge is then selected which will cover more than one inch beyond the edge of the ulcer area. Several layers of fluffed gauze are then placed over the ulcer to absorb the discharge. Next the rubber sponge is applied and over this a layer or two of sheet wadding. This tends to keep the secretion localized in the dressing and the bandage from becoming soiled. The sponge and dressings are then bound in place by a four inch cotton gauze bandage, snugly wrapped, inasmuch as it is difficult to hold the sponge in place when putting on the tight elastic bandage later on. Some strong elastic type of a bandage, similar to the Ace, and preferably four inches in width, is then wrapped on the leg beginning just below the knee. The author prefers to wrap from the knee toward the toe instead of the theoretically correct method of from the toes upward toward the knee.

By wrapping in this direction the bandage can be more easily and evenly applied. This bandage must be put on just as tight as the operator can draw it. The tighter this bandage is placed, and the larger the rubber sponge over the infected area, the more quickly will the patient be relieved from his pain, and the more rapid will be the recovery of the condition present. The patient is then instructed to walk and the author *emphasizes* very strongly the fact that he *should walk* in order to get the best results.

The case will not be improved materially in any way if after the leg is bandaged the patient is allowed

to go home and go to bed. If on the contrary the patient is instructed to *walk* and if *he does so,* even though the condition is painful for the first hour or so, you can assure him very positively that he will practically be free from pain within two to three hours and with that assurance, the average patient is very happy to endure pain thinking of the relief that he will obtain. The pain at times is so severe that he is given a sedative tablet to control it.

If the ulcer is extensive with a large amount of secretion present the dressing should be changed and the ulcer and leg bandaged every day. On the other hand, as rapidly as the secretions become minimized and lessened, and the condition is brought under control the dressings may be extended to every second or even every fourth day as the condition demands.

It is very essential, however, that the rubber sponge pressure and the firm elastic bandage be continued throughout this treatment. Under the sponge pressure with the supportive bandage the large coarse hydropic granulations will rapidly be killed off and the fine normal granulating area will develop. The secretions from the ulcer will become lessened, the necrosis will seem to disappear and the general appearance of the ulcer, similar to a badly infected carbuncle, will become a thing of the past. Coincident with this change the tissues about the ulcer will lose their dark cyanotic, congested, appearance, and will tend to become more normal in appearance.

As soon as the granulations become flattened out and the secretions become controlled, the color and appearance of the tissues become practically normal, the rubber sponge may be eliminated but the support with the compression bandage must be continued throughout the entire course of treatment and for a long time after the ulcer has healed. Under this method of treatment all *varicose* ulcers will rapidly improve and can be healed comparatively quickly and yet the patients not lose time from their work.

At the proper time judicious use of skin grafting will very materially shorten the period of healing. This, however, should not be done until after careful and complete sclerosing of all the offending veins and the complete elimination of the lymphangitis and the extensive tissue infection about the ulcer. The ulcer bed should be carefully prepared, as for any skin graft.

PREPARATORY TREATMENT FOR SKIN GRAFTING OF VARICOSE ULCERS.

1. Preparation of the skin area from which the graft is to be taken. This is done with a thorough scrubbing of green soap and the application of alcohol packs for twenty-four hours before the operation.

2. Preparation of the ulcer area: (*a*) Treat aseptically (with gloves) from the first. If the ulcer is badly infected and has not had the preliminary ambulatory care and treatment or if it persists infected severely in spite of that, wet packs of zinc sulphate

1 per cent. and copper sulphate 2 per cent. are applied over the ulcer area for four to five days. This tends to freshen and cleanse the ulcer area. At times the application of Dakin's solution at intervals of twelve to twenty-four hours seems to speed this period of treatment. Dakin's solution, however, in these cases is usually quite painful and personally the author uses it but little. If the case has not been extensively infected the continuous application of plain normal saline packs, for two to three days before the date of operation will oftentimes get the ulcer in ideal condition. All this preparatory treatment to the ulcer itself should be done in a most aseptic manner even though we are dealing with an infected ulcer area.

3. The operation of skin grafting. Continue the asepsis the most perfectly possible. At the time of the operation, the area from which the graft is to be taken is thoroughly cleansed again with ether or alcohol and then wiped dry. No other antiseptic solution is applied to this area, whatsoever. No saline is used on this area at the time of cutting the graft. No antiseptic other than ether is used about the ulcer area. This is best to cleanse the secretion from the skin and ulcer bed.

The skin grafting should not be undertaken until all the coarse hydropic granulations have disappeared, not until the infection has been cleared up and not until the ulcer bed is covered with fine epithelial granulations. Gentle cleansing of the ulcer itself with peroxide and ether is sufficient, inasmuch as we

have had our sterile dressings on for several days. Be very careful not to cause free hemorrhage. No free curetting, as is often seen, is permitted. Gently brush the ulcer area with gauze, stimulating very slight oozing. Either the Thiersch or Riverden skin graft may be used.

The author prefers the latter. At times the pedical flap may be advised, though the author has never used it. In case the Riverden skin graft is to be used the graft must be very thin, and at no time must it go to the lower layers of the skin. The thinner the graft the greater will be the possibility of a take and the larger percentage of success. The grafts are best taken from the thigh, either outer or inner. The outer surface of the thigh seems to be less painful to the patient postoperative. The strips are best taken about two inches long and carefully placed and flattened out over the ulcer area.

One flap after another is thus taken until the entire ulcer area is covered. The operator must be very careful to smooth out and to flatten all grafts. He must see that no air bubbles are held under the grafts and that the grafts are applied directly to the granulating surface. The entire area of the field grafted is then covered with strips of gutta-percha about one-half inch wide. Silkaloid or other similar materials may be used. These strips are placed crosswise of each other entirely covering the field in one direction and a second layer covering the first in the

other. Postoperative wet saline packs are applied over the gutta-percha strips for one to two days.

These packs are repeatedly soaked every four to six hours and thus keep a continuous wet saline pack. These dressings are not changed until the fourth day and it is very essential that the dressing be soaked from four to six hours with warm normal saline before the changing. At the time of the first dressing it is very essential that the dressings be removed carefully, one at a time. The author prefers not to disturb the gutta-percha strips at this time, unless there is much oozing and discharge of pus between them. If this be the case then they must be removed, the wound cleansed with normal saline on cotton applicators, the graft area then dried and new strips of gutta-percha applied covering the field as at first.

The author prefers to continue the saline packs for another three days or until the end of the first week. After that the dressings are left with a plain dry dressing, preferably an air dressing. At any time that the granulations seem to develop and overgrow the grafts the normal saline packs should be applied. It seems to control the excessive granulation development.

After about the tenth day the grafts are entirely left uncovered, either protected with a shield over the whole extremity or the grafted area itself being protected with a perforated paraffin gauze dressing. During this period the entire leg must be supported

and slightly elevated above the level of the body, in order to compensate for the pathological circulation. The area in the thigh from which the graft was taken can be dressed with a paraffin dressing or with a normal saline dressing, while other patients seem to be more comfortable when this area is dressed with some ointment dressing, similar to that used for the ulcer area itself. The patient apparently gains more comfort from a normal saline pack to this area for the first forty-eight hours followed with the ointment dressing after that, though a little more difficult to apply.

The ointment dressing is continued to this area until it has practically healed and after which time the patient is very comfortable with a thin gauze dressing for another week, the same as with any freshly healed wound.

Usually at the end of two weeks and often times less the ulcer area will be practically covered with new skin. Most of the grafts take primarily and the remaining ulcer area between them becomes covered by extension from the grafts.

SUPPORTIVE MEASURES.

As soon as the ulcer is practically healed and dry an Unna cast is applied and the patient allowed to get out of bed. It is very essential that the patient does not leave his bed or let the extremity rest in a pendant position until it is first supported by means of the Unna cast. This cast, as has been discussed, has

both the means of support plus the healing effect of its contained medicament. After the cast is applied the patient is permitted to get up in the chair and begin to walk. In order that the ulcer area, or the grafted area rather, may be inspected and that the operator may know that everything is proceeding normally the first cast is removed at the end of one week.

At the time of this removal the ulcer, as well as the tissues about, are cleansed with benzine. Unless some other condition has developed which must be taken care of according as the condition may demand a new cast is applied. The new cast applied at this time may remain on two weeks during which time the patient is allowed to walk about at will and in fact the author *prefers* to have his patients walk during this period. At the end of two weeks, or sooner if the patient complains of pain or if discharge is noticed oozing through the cast, it is removed, the leg is inspected, and if things are proceeding normally, a new cast is applied which may be left on two, three or four weeks, at the option of both the physician and the patient.

In his *Clinic material* the author has many patients who receive new casts once a month. The private patients at times will prefer the use of the Unna's cast, in view of the fact of the results obtained, yet others demand some more modern and cosmetic measure. The latter patients may use either the elastic stocking woven and made to measure, a pure paragum rubber stocking or the Mac canvas

boot, which in fact, seems to be giving very good satisfaction. None of these measures, however, have given 100 per cent. satisfaction. The Unna's cast is clumsy and unsightly. It is very satisfactory for the working man. For the society woman or a person particular about his appearance it does not meet the requirements. The woven elastic stocking at first gives the support needed, gives comfort and does not look unsightly. After two to three months, however, it becomes stretched, the rubber bands give way or become rotted, the stocking will become wrinkled and stretched and at this time it is of but little use and value and it is also an unsightly thing.

The pure para-gum rubber elastic stocking or the reducing stocking is very efficient and works well in some patients. If the patient is prone to perspire freely it is very uncomfortable and due to the perspiration it rots and becomes rapidly destroyed. For this particular patient this stocking will not last for more than two to three months. Some patients prefer the four inch roller bandage of the woven elastic type before mentioned, which they can wash at will and can reapply themselves every few days as needed. This, however, takes much care and the patient is prone to leave it off and unless it is carefully and conscientiously applied the continued support may be lost. If it is carefully used, conscientiously applied from day to day, and washed and stretched every five to six days it is very satisfactory and efficient.

The Mac canvas boot, which the author has recently devised and has had made by the Buchstein

Company of Minneapolis, seems to meet the requirements the best of anything which he has as yet seen. This is simple, easy to apply, and seems to be efficient. it is made both of a very thin yet stout canvas, colored if desired, or of a woven cloth similar to underwear. These boots are made to measure to fit the individual leg and with the toe and the heel cut out. The canvas boot laces from the toe up the front to the top. The patient soon learns how to adjust the lacings so as to make the boot comfortable at all times. For the working man or woman who has to be on the feet long hours at a time, and who cannot afford the expensive elastic stocking, this in the opinion of the author is the most efficient of any mode of support yet devised.

Need for Continued Use.—In all cases of varicose ulcers it is very essential that the patient be informed in regard to the pathology present, regard the etiology of the case or causative factors in it, the circulatory conditions, and the theory of the supportive measure, etc. This is done in order that he may carefully and correctly take care of himself in the future. Though we have healed the ulcer and though the patient is temporarily cured from his condition, yet our duty to him has not ceased.

It is only under our continued supervision and care that this patient may remain cured the rest of his life. It is very essential in the extreme cases that these patients have the continued support to the extremity for many months after the healing has taken place.

If this external support to the extremity is left off comparatively soon after the patient has been healed and discharged, in the course of only a few days, the leg will again become edematous, the tissues cyanotic, and all the factors be present for another break down.

On the other hand if this support is continued, the healthy condition of the tissues may be maintained, the nutrition of the tissues sustained and the patient may be kept healed the rest of his life. The patient should also be instructed as regards the importance of avoiding trauma to this area. Even though the ulcer has been healed, and even though the circulation of the tissues is restored somewhat to a normal state, they are not yet able to sustain the destructive effect of injuries as in their normal condition. The patient should be instructed always to step forward with the other foot and to take all measures in the attempt to try to avoid trauma to this area.

If the patient should bruise the ulcer area at some time later it is very essential that he take the utmost care immediately thereafter. He should immediately report to his physician for supervision.

Here again the valuè of the supportive measures and careful attention cannot be over emphasized. If this patient, the victim of a former ulcer, which has been healed and kept healed for months or years, presents himself with the new tissue ready to break down and with a cellulitis locally, the whole condition can be cared for and corrected by the application of the large rubber sponge plus the elastic bandage. In the

course of a few days this destructive process can be entirely headed off and the condition brought back to its apparently normal state. This is the same supportive treatment used to begin with and is of particular value for this condition.

Some cases which have not responded under the usual and ordinary treatment in the past have responded well and healed rapidly when the treatment was supplemented by parathyroid therapy which has been used and tried out.

The author's experience agrees with that of most other men that parathyroid therapy by mouth is useless. He has never been able to convince himself of any definite value gained from its administration in this matter. The active hormone of the parathyroid gland prepared according to the technic of Dr. Adolph Hanson under the name of Paroiden has been of very definite value. Under the hypodermic administration of this the blood calcium has been very definitely raised to and at times above the normal. He is still undecided, however, as to what particular case is suitable for and should have this additional treatment.

CHAPTER XXI.

THE ZINC-GLUE BANDAGE.

The use of gelatin in dermatological practice was early recognized as of great value; however, it was Unna who is supposed to have been the first to adopt it and combine it with other materials, for the use and treatment of ulcers of the lower leg.

The gelatin is very soothing for the skin. It acts as a supportive body, measure, or medium to carry any medicament with which it is mixed and acts as a support for the extremity about which it is applied. It is sufficiently porous to allow for evaporation of perspiration, if it is not made too heavy. The glycerin is also sedative and soothing, and due to its affinity for water helps care for the excessive perspiration. The zinc oxide is a mild antiseptic.

The exact formula of Unna and the one which the author prefers to use in his Clinic is:

℞ Zinc oxide	30	parts.
Phenol	2	"
Gelatin	30	"
Glycerin	50	"
Aquæ	90	"

At times it may be expedient to incorporate in this mixture ichthyol or other drugs. This can be very easily done and is a very convenient method of applying these preparations to the skin. The author

prefers to use the ground gelatin as that is much more easily brought into solution. Any preparation, however, of gelatin may be used. The gelatin is first mixed with the water which should be boiling and the container should be a part of a double boiler or a water bath. The glycerin and zinc oxide are carefully mixed together so as to give a very even homogeneous mass. After the glycerin and zinc oxide have been mixed and the gelatin is fairly and completely dissolved in the hot water the zinc oxide and the gelatin are poured together and the whole mixture then carefully stirred for complete and even mixing. If for cosmetic reasons, to satisfy certain fastidious patients, it is desired to have this cast material a pink instead of white this can be easily accomplished by adding any type of coloring as carmine, or any one of several on the market. After the solution has been thoroughly and completely mixed it is set aside to cool, when it forms into a sem-solid mass.

When needed for application, the container with this material, is put in a pan of hot water and it soon softens up. It should be heated until it is very warm, yet not hot. The actual application of the Unna's ointment, or zinc-glue-gelatin paste to the extremity is as follows: With a two inch brush or with the hand apply the softened liquid to the extremity from the knee to the toes. Then wrap the extremity with ordinary plain cotton gauze bandage, being very careful to leave no ridges over the tibia. Fold the bandage

posteriorly so as to give an even wrapping of the gauze. This is continued from knee to toe leaving the heel uncovered.

A white cotton stocking may be used instead.

Over the layers of this bandage are then applied a layer of the Unna's paste which is thoroughly rubbed into the bandage. If a large ulcer is or has been present a reinforcement over this area is made by dipping a large square dressing of gauze into the Unna's material and placing it over this area. Another layer of gauze is then applied from the knee to toes which incorporates the reinforcement of gauze into the cast. After this second layer of gauze is applied another application of the Unna's glue is thoroughly rubbed in this gauze and the whole cast is then allowed to cool. In the course of about ten minutes, this gelatin bandage has become set and the patient may put on his stocking and go about his work.

The combination of the zinc oxide, the gelatin, and the glycerin impregnated into the bandage gives a supporting cast, which, when about four to six layers of gauze has been used, will give continued support from three to four weeks before it begins to wrinkle and become uncomfortable.

The essential points in the application of this cast are: To avoid wrinkles in the bandage over the tibia or over the foot, to place the gauze layers as evenly and smoothly as possible, to have the solution well mixed, to rub it in thoroughly and impregnate it into

all the layers of gauze, and to place supportive layers of gauze along the calf and over the ulcer area, to reinforce the cast which will lengthen its life and prevent wrinkling over a much longer period of time. In the hot summer weather, it is advisable to increase slightly the content of gelatin, while in the cold weather the gelatin content may be somewhat decreased. By means of this zinc-glue bandage, support may be given to the extremity as long as needed or throughout the remainder of the patient's life. If this continued support is maintained the patient can be assured that his ulcer will never develop again.

CHAPTER XXII.

TREATMENT OF THE COMPLICATIONS ASSOCIATED WITH VARICES.

Thrombophlebitis.—An acute infectious thrombophlebitis of the *deep* veins of the lower leg is best treated, when seen in the early stages, by absolute rest in bed with elevation of the extremity and the application of ice packs to the whole leg. In the later stages the condition is very definitely improved and recovery is hastened by the application of continuous heat and high elevation of the affected member. Medication has but little proven value, though a legion of drugs have been recommended. The patient must not be allowed to leave the bed, however, until the edema is gone, all pain has disappeared, and the temperature has been normal for at least several days.

Acute infectious thrombophlebitis of the *superficial* veins of the lower leg is entirely different from the condition just discussed. This condition is often the predisposing cause and early stage of the development of a varicose ulcer and responds to exactly the same treatment as does that.

Regardless of when or in what stage this condition is seen it must be regarded as the early stage of a potential varicose ulcer. The leg should be immediately bandaged, using the "Ace" bandage, with

a large rubber sponge covering the entire area of the thrombophlebitis as described under the treatment of Varicose Ulcer (page 170). With this treatment the patient may be allowed to get up and walk instead of going to bed as has been the treatment in the past. The rubber sponge must not be applied directly to the skin as it will burn and blister the surface. Several layers of gauze should be placed over the area protecting the skin from the rubber. This bandage and sponge should be renewed about every two to four days.

At first the condition will be so painful when the bandage and sponge are applied that the patient will need sedative tablets to relieve it. After this infectious thrombophlebitis is entirely quieted down and the condition becomes practically normal, the author always urges his patients to immediately proceed to have the remaining varices injected and sclerosed before a recurrence of this condition may develop. There seems to be but little need of worrying about the flaring up or a recurrence of this thrombophlebitis following the injection, if a period of four to six weeks has elapsed since the condition has entirely quieted down. This period, however, and the date of the injection treatment must be settled and decided with each case separately and by itself.

An acute infectious, thrombophlebitis of the large varices, size four, in the thigh is somewhat different than that of the superficial veins of the lower leg inasmuch as you cannot bandage the thigh to continue

your pressure due to the fact of it being large above and small below. The bandage will immediately slip and become loose.

Much comfort, rest, and support, can be given the patient with this condition if the entire area is supported with adhesive strips four to five inches wide and about two-thirds encircling the extremity. They should be applied from two inches below the lowermost area of the phlebitis with the upper strip of adhesive overlapping the lower about one inch and sufficient strips applied to come approximately two inches above the upper area of the phlebitis. This support of adhesive will remain in place and need not be changed for several days and the patient will derive a large amount of comfort from its application. By means of it the patient may go about his daily work, resting as much as possible and applying the hot water bottle or local heat whenever the opportunity presents, however, they are not compelled to go to bed and the author does not believe their period of recovery is delayed by not doing so.

There are certain authors and surgeons[1,2] who advise the radical resection of this area of acute infectious thrombophlebitis. To the author, this seems most radical, and the possibility of an infectious thrombophlebitis developing in the other veins following the operation is certainly present. The measures that the author advocates on the other hand are very conservative or rather "conservative in the extreme." They permit the patients to continue about

their daily vocation, whereas the surgical procedure demands that the patient be at absolute rest in the hospital for some period of time and for this reason one can hardly be compared with the other.

Ulcer cruris and its treatment has been discussed in a previous chapter.

Eczema.—Eczema with its associated pruritus is a very common complication of varicose veins and particularly where we have ulcerations develop. This eczema is usually of the moist type and is very intractable. Even though it may be cured it is very prone to recur. The pruritus associated with it may be very intense and oftentimes unbearable.

At times the eczema and pruritus will respond almost immediately to the obliteration or injection of the large varices which seem to feed in to that area. Again it will persist in spite of the obliteration of all varices present and is very obstinate and resistant to any local measures. It at times may exist over the whole leg. It is best cared for by two applications each day of Burrow's solution, 1 : 10. This is a solution of aluminum acetate plus a small amount of acetic acid. Some advise the use of the aluminum subacetate in 8 per cent. solution and then dilute it 1 ounce with 500 cubic centimeters of water. This is applied in the form of continuous wet packs. In many cases this gives ideal results, though some cases are very resistant even to this treatment.

Some cases respond quite well, according to Sicard, to autohemotherapy. In his clinic he uses

the injection of 20 cubic centimeters of the patient's own blood drawn from the bicipital vein and injected deep into the muscles of the buttocks three times a week. In the author's experience, however, such astounding cures from this treatment have not been seen. Other men feel that the injection of two to three cubic centimeters of blood once a week in the same method and manner is just as efficient. Recently the author has been using an ointment according to the formula of Professor Sicard, as follows:

℞ Tar or ichthyol ..... 3.
Vaseline,
Lanoline,
Zinc oxide .....āā 10.
Apply the above widely and use compressive bandage.

In several cases the most intractable eczema with intense pruritus has responded to this ointment where they have responded to no other mode of treatment.

Eczematoid Ringworm. — At times there is a fungus infection similar to what Strickler calls eczematoid ringworm and caused by the *Epidermophyton* fungus. This begins in the tough cornified skin near the sole of the foot and between the toes. At times the whole skin will form large, very tender, painful blebs filled with a translucent fluid. In extreme cases the tough skin becomes whitened and macerated and will peel off in large areas leaving a secondary infected base.

This condition is also best treated by Burrow's solution, though at times it is very resistant and must

be treated persistently and stringently with some ointment such as Whitfield's ointment. This is a preparation of salicylic acid and benzoic acid and has a marked keratolytic effect.

Recurrences are common after any treatment. At times the air cooled ultra violet light locally does seem to improve this condition.

Impetigo.—Occasionally there will be seen a condition similar to an impetigo involving the whole lower leg, knee to ankle. The skin has not broken down into large open ulcers but on the contrary there may be many small ulcerations and the whole lower leg may resemble a large carbuncle. This condition responds very well as a rule to the application of Burrow's solution and Sicard's ichthyol ointment on alternate days with the supportive bandage all the time. As a rule the condition is brought under control in a comparatively short time. It is in this condition, however, that the author believes there is more possibility of a septicemia developing following the injection treatment than in any other, and he would urgently advise in these cases to make no injections until the infectious condition is well under control.

CHAPTER XXIII.

ELEPHANTIASIS.

Elephantiasis is a disease most often met with in tropical countries, such as the West Indies, China, Japan, etc., where it occurs as an epidemic infection caused by the *Filaria sanguinis hominis*. Sporadic cases are seen in the temperate zones due to infection by many different germs complicating other conditions. It most often involves the lower extremities though at times the genitalia. The true filarial type is not often seen in the northern climates though the author has had the opportunity of seeing several cases. It gets its name elephantiasis from the tremendous size the leg will at time assume.

The pathology is due to an obstruction of the lymphatic channels in the superficial fascia of the lower leg blocking the lymphatic drainage. Due to this blockage and to the infection present the superficial fascia becomes hard, indurated and fibrosed. The extremities are not truly edematous. They do not pit well on pressure as is seen with the usual edema but the tissues are more wood-like in appearance. The area involved is usually from the knee to ankle. The supporting effect of the shoe placed tight on the foot often seems to control the infection there.

The lower leg loses all shape and becomes an unsightly club. Oftentimes it is unilateral though very

often it is bilateral. At times it also extends up the leg involving the thigh or the genitalia. At times it occurs in the upper extremities as well but not so often as in the lower leg. The infection begins with severe constitutional symptoms and oftentimes with a severe chill which may last several minutes to an hour, following this the patient will have a high fever, at times as high as 103° F. to 104° F.

Associated with and following this onset, the lower leg or the part involved, becomes very tender, swollen and at times reddened. There is much pain present, throughout the area involved. During the early stages the attacks are prone to come in cycles of every few months. With rest in bed and heat the attacks seem to subside leaving in their trail the remnants of the infection in the way of a sclerosis of the tissues. Following each attack the extremity increases in size according to the amount of destruction of the lymphatic circulation and the blockage of the lymphatic drainage. At times it may assume an enormous proportion. The skin becomes very tough, indurated and thickened and gives the feeling and appearance of elephant skin.

Eczema, pruritus and ulceration, though never deep or extensive are prone to occur coincident, secondary and associated with this condition. The skin becomes deeply pigmented due to the chronic congestion.

The treatment is best divided under palliative and curative. For the attacks the patient must be put to

bed, if possible, with elevation and with heat locally. If the patient is unable to leave his work and go to bed much relief and comfort can be given by very tight bandaging of the entire extremity involved with four and five inch elastic bandages. These,

Fig. 35.

Mrs. R. E. Elephantiasis.
Before treatment.

however, must be wrapped *unusually* tight and with the extremity so wrapped the patient may go about his work. They seem to recover from the attack more rapidly when they are about than when they go to bed.

Following the attack the supportive treatment is

continued by means of the bandages, carefully and continuously wrapped or by means of the Unna's supporting cast. If this supportive treatment is continued and carefully watched it has been the author's experience in the few cases that he has had that

Fig. 35.
After treatment.

the attacks become farther apart and much less severe in their development. In fact the patients have been so comfortable with these supportive measures in comparison to the misery which they have undergone previously and in relation to the discomfort, pain, expense and disability entailed, seeking surgical re-

lief, that they have chosen to continue with these palliative measures (Fig. 35).

In the past, as well as at the present time surgery has seemed to hold the best hope for cure for these patients. This has been by means of the Kondeoleon operation. The purpose of this operation and the theory upon which it is based is a redevelopment of the lymphatic drainage for the extremity by excising large wedge shaped pieces of this sclerosed and fibrosed superficial fascia together with sections or pieces of the deep fascia leaving the muscles of the lower leg exposed.

This is done in the hope that direct and new channels of lymphatic drainage may be established from the superficial fascia directly through the muscles to the deep system. In the hands of some surgeons this seems to have given good results, yet other men reporting on large series of cases are not so enthusiastic about results obtained. Personally the author is in favor of the palliative supportive treatment in preference to the extensive operative work involved in the Kondeoleon operation.

CHAPTER XXIV.

HEMORRHOIDS.

Hemorrhoids or "piles," as they are commonly called, are dilatations or varicosities of the veins of the anal canal and lower rectum. They are abnormal and pathological dilatations of the terminal hemorrhoidal veins similar to the varices of the lower extremities. Both are of the spongiose and ampullar types.

The pathology of varicose veins and hemorrhoids is very much similar while the etiology of both is oftentimes obscure.

The treatment of this condition has always been surgical and the results, as a rule, have been good.

Modern medicine and surgery, however, attempt to save the patient disability from work and to avoid hospitalization whenever possible. In no field has this been accomplished more than in the modern treatment of hemorrhoids by the injection method. According to certain authorities on the subject, 90 per cent. of cases uncomplicated by ulceration and acute crises, can be cared for by this ambulatory method. It is used and advocated by many of the most eminent proctologists both in this country and abroad.

The cure of the hemorrhoids by the injection of solutions either into the varix or perivascular is based on the sclerosing and fibrosing effect of the injected

fluid. The pathology following the injection and producing the cure is the same as that following the injection treatment of varicose veins. This has been discussed in detail in the chapter on Pathology.

The author has not had sufficient experience with this treatment to justify any attempt to criticise or advise as regards the use of any particular technic or solution.

Many articles have been written and several books have been published on the subject and the author would much prefer to refer the reader to those for his information. The books by Montague, Pruitt Morley and Blanchard are the best, while the writings of Fansler[52] cover the subject well in separate presentations. Of the other writers Terrell[55] and Boas[57] have had the widest experience and their opinions are well founded. Their technic is simple and their results are good.

BIBLIOGRAPHY

1. Sabrazes, J.: Pathologic Anatomy and Pathogenesis of Varices. Presse therm. et. climat., Paris, 1927, lxviii, 353–361.
2. Bernstein: Aage, De Varices Du Membre Infereur Specualment, Au point de vus de l'etolgie et du treatment chirurgical. Acta Chirurgical Scandinavica, lxii.
3. Kampmeier, O. and Birch: The Origin and Development of the Venous Valves, with Particular Reference to the Saphenous District. The American Journal of Anatomy, xxxviii, 1926–1927, p. 451.
4. v. Bardeleben, K.: Das Klappen-Distanz-Gesetz. Jenaische Ztschr. f. Naturwiss, 1880.
5. Delbet, Pierre and Mocquot: Varices of the Legs. "Annals de la clinique chirurgicale" of Prof. Delbet (Felix Alcan, Paris, 1913).
6. Lehmann, E.: Etiology, Pathogenesis and Histological Structure of Varices. Frankfurt, Ztschr. f. Path., Wiesb., 1925, xxxiii, 300–326.
7. Trendelenburg: Beitr. z. Clini. Chir., 1890, Bd. vii. H. 1, S. 195-210.
8. Nobl, G.: Pressure Treatment of Varicose Ulcers. Wien. klin. Wchnschr., 1924, xxvii. 644–646.
9. Nobl, G.: Artificial Obliteration of Veins Showing Varicose Degeneration. Wien. klin. Wchnschr., 1926, xxxix, supp. xlv, 1–16.
10. Sicard: Monograph, Mason et Cie, Paris.
11. Strickler: Skin and Syphilis, F. A. Davis Co., 1927.
12. Von Meisen: A Lecture on Injection Treatment of Varicose Veins and their Sequelæ (Eczema and Ulcer Cruris), Clinically and Experimentally. Acta. chir. scandin., Stockholm, 1926, lx, 435–462, 2 p. 1.
13. Nobl, G.: Varices der Venen der unteren extremitaten mit injektionen von Calerose losungen zwecks kunstilicher Thrombose behandelt. Wien med. Wchnschr., 1926, lxxvi, 1280.
14. Lowenfeld, W.: The Bacterial Flora of Varicose Ulcers of the Leg. Wien. klin. Wchnschr, 1924, xxxvii. 502.
15. Régard, G. L.: Treatment of Varicose Veins by Injections Inducing Sclerosis. Rev. med de la Suisse Rom., Geneve, 1925, xlv, 102–107.
16. Mayo, C.: Surgery, Gynecology and Obstetrics, 1906, xi, p. 385.

17. Babcock: Journal of the American Medical Association, July 27, 1907.
18. McPheeters: The Injection *vs.* the Operative Treatment of Varicose Veins, a Statistical Report. (Awaiting publication in Surgery, Gynecology and Obstetrics.)
19. McPheeters and Rice: Direction of the Venous Flow in Varicose Veins, Experimental and X-ray Evidence. (Awaiting publication in Surgery, Gynecology and Obstetrics.)
20. Klotz, K.: Untersuchungen ueber die V. Saphena magna. Arch. f. Anat. u. Phys., 1887.
21. Hesse and Schaak, W.: Die Klappenverhältnisse der Oberschenkel-Vene Saphena Magna in ihrer klinischen Bedeutung für die Operation der Sapheno-femoralen Anastomose bei Varicen. Virchow's Arch., Bd. 205.
22. Hallion: Sur la physiologie patholigique et le traitment des varices. Rev. Prat. de biol. (etc.) Par., 1923, xvi, 225–257. Also translated Med. Presse, Lond., 1923, n.s. cxvi, 527–530.
23. Bazelis, Robert: Du traitement des varices et particulierement des injections phlebosclerosantes. Paris, 1924, 139 p. 80.
24. Homans, J.: Thrombophlebitis of the Lower Extremities. Annals of Surgery, lxxxvi, No. 5, May, 1928.
25. Bickhams: Operative Surgery, 1924.
26. Jentzer, discussed by A. L. Vischer, 1927, 1–3, Praxis Berne.
27. Tavel: Med. Suisse, Oct., 1904.
28. Mazzini, Osvaldo, F.: Treatment of Varices, Schiassi's Technique. Semana med., Buenos Aires, 1926, xxxiii. pt. 2. 80-825.
29. Linser, P.: Injection Treatment of Varicose Veins. Med. klin., Berl. and Wien., 1921, xvii, 1445–1447.
30. Linser, K.: Treatment of Varicose Veins with Local Injection of 15 to 25 per cent. Sod. Chloride Sol. Varicophtin. Dermat. Wchnschr. Leipz. w. Hamb., 1925, lxxxi, 1345–1351.
31. Kausch, discussed by G. Nobl in "Artificial Obliteration of Veins Showing Varicose Degeneration." Wien. klin. Wchnschr., 1926, xxxix, supp. xiv, 1–16.
32. Genevrier: Bull. Soc. Med. Milan, May, 1921.
33. Remenovsky, F. and Kantor, P.: A New Method of Treatment of Varicose with 50 per cent. Grape Sugar. Wien. klin. Wchnschr., 1925, xxxviii, 532–535.
34. Montpelier, J. and LaCroix, A.: Note au sujet de la fibrose curative des varices par les injections intraveineuses de büodure de mercure. Bull. Soc. franc. de dermat. et syph. Par. 1923, 53–56.
35. Ivanissivich, O.: Semana Med., Buenos Aires, 1924, xxxi, part 2, 1093.

36. Logefiel: American Journal of Medical Sciences. (To be published soon.)
37. LeBlaye, R. and Vandier, E. A.: Le chlorhydrate double de quinine et d'uree: ses applications therapeutique, notamment a la cure des varices. Bull. med. Paris, 1927, xli, 289.
38. Siebert, C. and Wreszynski, E.: Non Operative Treatment of Varicose Veins by Artificial Obliteration. Med. klin. Berl. and Wien, 1928, xxiv, supp. 1, 1–30.
39. Sicard, J. A., Paraf, J. and Forestier, J.: Le traitement des varices par les injections intravariqueuses de carbonate de soude. J. med. franc., Par., 1921, x. 377–384.
40. Forristier: Journal of the American Medical Association, June 16, 1928, xc, 1932–1936.
41. Douthwaite: The Treatment of Varicose Veins by Injection. Brit. Med. Jour., London, 1926, xi, 554.
42. McPheeters and Rice: Complications Direct and Associated Following the Injection Treatment. Journal of the American Medical Association, Oct. 13, 1928, xci, 1090–1094.
43. Pondorff, discussed by de Gaetano, in Ambulatory Treatment of Varicose Ulcer. Gazz. med., lomb., Milano, 1925, lxxxiv, 99–101.
44. Boynton, discussed by de Gaetano, see 43.
45. Von Meisen: Injection Treatment of Varicose Veins and Their Sequelæ on Basis of 500 Treated Cases. Actu. chir., Scandinav, Stockholm, 1927, lvii, 17–40.
46. Miller, Robert T.: The Results of Operative Treatment of Varicose Veins of the Leg by the Methods of Trendelenburg and Schede. Johns Hopkins Hospital Bulletin, xvii, No. 186.
47. Burke, Garry R.: Results in Porto Rico of the Kondoleon Operation for Elephantiasis of Extremities. Surgery, Gynecology and Obstetrics, Dec., 1928, lvii, No. 6.
48. Fansler, W. A.: A Critical Study of the Injection Treatment of Hemorrhoids. The Journal Lancet, Nov. 15, 1927.
49. Sicard, J. A. and Gaugier, L.: Treatment of Varices by Sclerosis Inducing Injections (sodium salicylate and others). Presse med., Par., 1926, xxxiv, 689–693; ab., Jour. Amer. Med. Assn., Chicago, 1926, lxxxvii, 283.
50. Nicholson, B. B.: Histopathology and Etiology of Varicose Veins. Arch. Surg., Chicago, 1923, vii, 47–63.
51. Nejrotti, G. M.: Pathogenesis and Cure of Varicose Ulcer of the Leg. Riforma med., Napoli, 1922, xxxciii, 10–12.
52. Fansler, W. A.: Ambulatory Treatment of Hemorrhoids. Minn. Med., Aug., 1924.

53. Fanslér, W. A.: Classification and Treatment of Hemorrhoids. Minn. Med., Aug., 1924.
54. Fansler, W. A.: History and Present Status of Injection Treatment of Hemorrhoids. Minn. Med., Nov., 1924.
55. Terrell, E. H.: My Present Views of Quinine and Urea in the Treatment of Internal Hemorrhoids. Amer. Jour. Surg., Dec., 1921.
56. Terrell, E. H.: Treatment of Hemorrhoids by Injection. Virginia Med. Monthly, April, 1926.
57. Boas, I.: Non-operative Treatment of Hemorrhoids. Deutsch. med. Wchnschr., Oct. 16, 1919.
58. Boas, I.: Injection Treatment of Hemorrhoids. Med. Clinik, June 11, 1922.
59. Dunbar, J.: Treatment of Hemorrhoids by Interstitial Injections. Brit. Med. Jour., Nov. 3, 1923.
60. Von Meisen: The Injection Treatment of Hemorrhoids. Acta chir. Scandinav., lx, p. 435 and lxii, p. 17.

INDEX

A

PAGE

Abdominal pressure and venous flow 48
Actinomycotic ulcers 63
Acute infectious thrombophlebitis 53, 69, 186
  radical resection of 188
Adhesive support to thigh 118, 188
Age in relation to varicose veins 36, 95
Amount of fluid injected 110, 112
Anatomy 11
Anatomy—microscopic 16
Armamentarium 97
Arthritis and varicose veins 40
Association of varicose veins with ulcer formation 63
Autohemotherapy and eczema 189

B

Bacteriology of ulcer cruris 60, 61
Bandage 97, 103, 170
Boynton adhesive strapping 162
Bichloride of mercury 87, 115
Biopsy specimens 136
Blanched ecchymotic spot 126
Burrow's solution 189
Bursts—skyrocket 35, 94

C

Calcification in varicose veins 133
Calcium balance in varicose ulcers 65
Calorose 85, 87
Cardiovascular cases and varices 94
Cellulitis about ulcerations 64
Changes in muscular coat following injection 140
Chemical periphlebitis 117, 118, 124
  thrombophlebitis 124, 150
Classifications of veins 11

PAGE
Complications associated with varices 53
injection treatment 154
following injection treatment 126, 128, 147, 143
operative treatment 79
Coronary thrombosis 154
Corrosive sublimate 115
Cramp following injection 122

D

Dermatitis and varicose veins 56
Diabetes and injection treatment 42, 155
Diagnosis and differential diagnosis of ulcers 61
Diagnosis and differential diagnosis of veins 39
Direction of flow in varicose veins 43

E

Ecchymosis 126
Eczema and varicose veins 56, 189
Elephantiasis 192
Embolus—occurrence of 52, 80, 147
Embryology of varicose veins 18
Endocrines and varicose veins 34
End results after injection 146
Equipment 97
Etiology of varicose veins 26
Expiration; effect of on venous flow 49
Extension of thrombosis 125

F

Fatalities 80
from pulmonary emboli 150
septicemia 153
Follow-up injections 119

G

Grape sugar 85

H

Hemorrhagic varices 57
Hemorrhoids 197
Heredity and varicose veins 38

PAGE
History of injection treatment 82
Histology of normal veins 132
varicose vein 133
after injection 134

I

Ichthyol in treatment of eczema 190
Impetigo 191
Indications for injection treatment 92
Infection theory of varicose veins 32
Infectious thrombophlebitis 152
Injection treatment, history of 82
Inspiration, effect of venous flow in varicose veins 49
Intra-abdominal pressure and venous flow 48
Introduction 3
Invert sugar solution 85, 87

L

Late results of injection treatment 130, 132
Lipiodol demonstration of varicose veins 46
Lymphatic injury in thrombophlebitis 56

M

Mac canvas boot 178
Malignant or rodent ulcers 62
Mayo operative treatment of varicose veins 74
Menopausal arthritis 41
Mercury biniodide 125
Milk leg (phlebitis) 41, 53
Mortality of operative treatment of varicose veins 77
Muscular activity and venous flow 48

N

Needle 98
Number of injections 110

O

Ointments in ulcer treatments 161, 162, 191
Operative treatment of varicose veins 71
complications following 79

Operative treatment of varicose veins (*continued*). PAGE
mortality following 77
recurrences following 78
Organization of thrombus 134

P

Pain and varicose veins 40, 41
ulcers 65
at time of injections 122
in varicose ulcers 170
Parathyroid in treatment of ulcer cruris 181
Paroiden in treatment of ulcer cruris 181
Penetration of vein wall by injected fluid 135
Perthe modification of Trendelenburg 45
Phlebitis——acute infectious thrombo 41
Pick-up injections 119
Post injection treatment 117
Pregnancy and varicose veins 93
Pressure bandage for large veins 114
Pruritus and eczema 189, 190
Pulmonary embolus 52, 80, 147
infarct 149

Q

Quinine and urethane 85, 112

R

Reaction following injection treatment 117
Recanulization 115, 120
Recurrences 120
Results of injection of varices 122
Ringworm of foot 52, 190
Rodent or malignant ulcers 62
Rubber sponge in treatment of ulcer cruris 104, 170

S

Salicylates—solution 112
Sclerosing phlebitis 150
Secondary injections 119
results of injections 124
Sex—in relation to varicose veins 36
Sicard's ichthyol ointments and eczema 190

PAGE
Silver nitrate 156
Size of veins 13
Skin grafting 172
Slough—cause of 126
sign 126
treatment of 126, 128
Sodium chloride 85, 87
Solutions used 87, 90
Spider and skyrocket varices 94
Sponges 104
Supportive treatment for varicose ulcer 167, 170
Syphilis and varicose ulcers 61
Syringes 35, 97

T

Table 104
Technic of injection 105
Thromboangiitis obliterans 155
Thrombophlebitis—acute infections 53
treatment of 186
deep 54
migrating type of 54
superficial 53
Thrombus formation 114, 148
Tourniquet 103
Treatment of slough—preventive 126
Treatment of slough 128
veins in general 66
(palliative) 69
operative 71
ulcer cruris 156
surgical 165
complications associated with varices 186
Trendelenburg states 44
tests 45
test—Perthe's modification of 45
Trophic ulcers 63
Tuberculosis ulcer 62

U

Ulcer cruris—bacteriology of 60, 61
cause of 166

Ulcer cruris (*continued*). PAGE
differential diagnosis of 61
etiology of 58
injection treatment associated with 167
pain in 170
parathyroid extract in treatment of 181
pathology of 60
recurrence of 180
rubber sponge pressure 170
summary of 169
supportive treatment of 167, 170
surgical treatment of 165
treatment of 156
Unna's cast in treatment of 179
Unna's cast 162, 176, 177, 182

V

Vaccine treatment for varicose veins 162
Varices and cosmetics 94
Varicose ulcer—*See* Ulcer Cruris.
Varicose veins—association with ulcer formation 63
classification of 11
diagnosis of 39
direction of venous flow in varicose veins 43
etiology of 26
frequency of 36
size of 13
valves—development of 9, 24
Venitis of Sicard 150, 151
Venous septicemia 54
Vulvar varices 94

W

Walking in treatment of ulcer cruris 170, 177
following injection treatment 113
Whitfeld's ointment 191

X

X-ray demonstration of injected fluid 135
proof of reverse flow in varicose veins 43

Z

Zinc-glue bandage 182